NOLOGY DEPARTMENT

# THE CHEMICAL AGE

VOL LVI 29 MARCH 1947 No 1446

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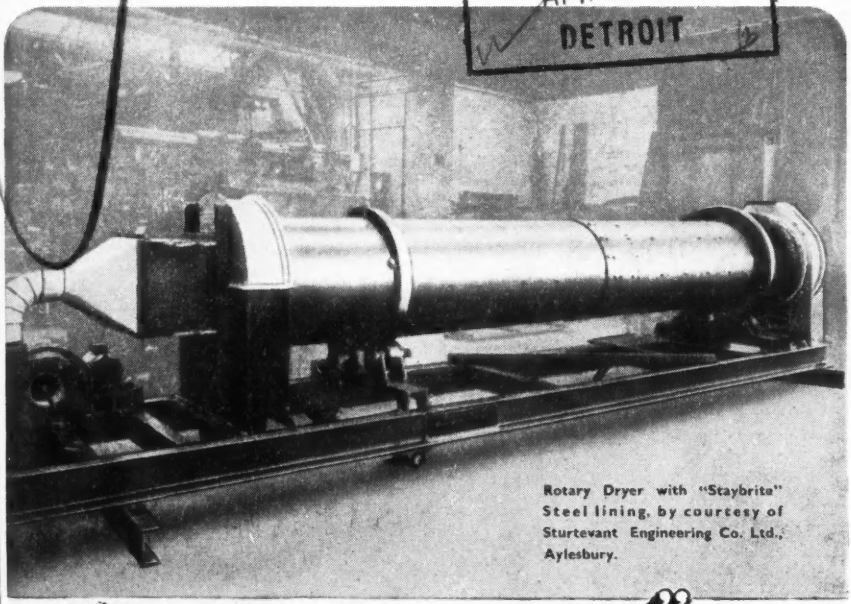

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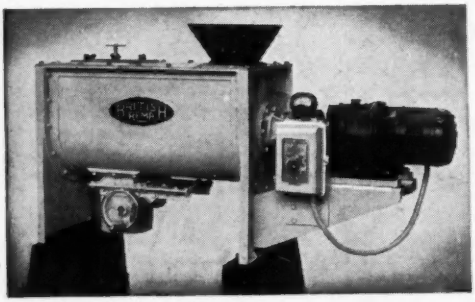

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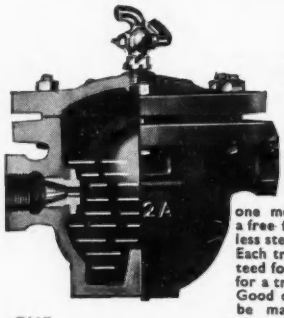

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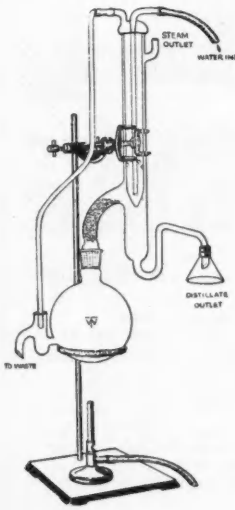


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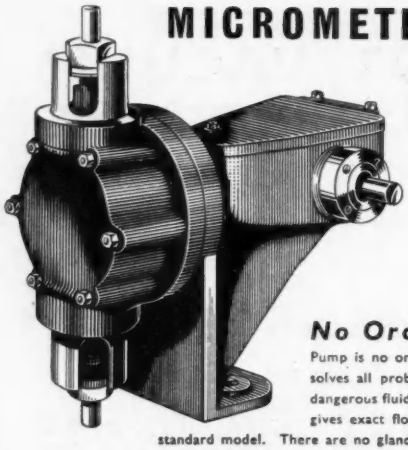

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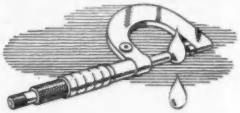

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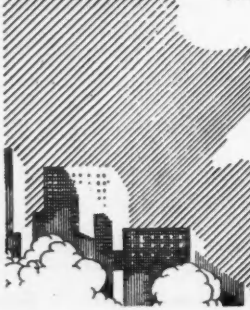

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*Write in Confidence to* — THE TOWN CLERK · HULL

# INDEX TO ADVERTISERS
## IN THIS ISSUE


| | Page |
|---|---|
| Air Conditioning Corporation (Jeffreys) Ltd. | xiv |
| Allen, Athole G. (Stockton), Ltd. | ix |
| Allen, Edgar, & Co., Ltd. | Cover ii |
| Automatic Coil Winder & Electrical Equipment Co., Ltd. | viii |
| Baker Perkins Ltd. | xvii |
| Balfour, Henry, & Co., Ltd. | xv |
| Blackwell's Metallurgical Works Ltd. | xix |
| Bose Productos Quimicos | 396 |
| Boots Pure Drug Co., Ltd. | 395 |
| Bowmans (Warrington) Ltd. | xix |
| British Gas Council | vi |
| British Tar Products Ltd. | xviii |
| Brough, E. A., & Co., Ltd. | iv |
| Cruickshank, R., Ltd. | Cover ii |
| Cyclops Engineering Co., Ltd., The | x |
| Dryden, T. | xiv |
| E.C.D., Ltd. | ii |
| Feltham, Walter H., & Son, Ltd. | 396 |
| Firth-Vickers Stainless Steels Ltd. | Front Cover |
| Foxboro-Yoxall Ltd. | vii |
| General Metallurgical & Chemical Ltd. | iii |
| Harris, Francis W., & Co., Ltd. | xix |
| Haughton's Metallic Co., Ltd. | xix |
| Hull, City of, Development Committee | ii |
| Imperial Chemical Industries Ltd. | v |
| Jobling, James A., & Co., Ltd. | xii |
| Kent, James, Ltd. | Cover iii |
| Kestner Evaporator & Engineering Co., Ltd. | iv |
| Key Engineering Co., Ltd., The | Cover ii |
| Leeds & Bradford Boiler Co., Ltd. | xxii |
| Leigh & Sons Metal Works | xix |
| Lennox Foundry Co., Ltd. | xix |
| London & Lancashire Insurance Co., Ltd., The | Cover iii |
| Metropolitan-Vickers Electrical Co., Ltd. | Cover iv |
| Mirrlees Watson Co., Ltd., The | vi |
| Mirvale Chemical Co., Ltd. | xvi |
| Mullard Wireless Service Co., Ltd., The | xii |
| Murex Welding Processes Ltd. | xvi |
| Negretti & Zambra Ltd. | xiv |
| Norman Engineering Co. (Great Britain), Ltd. | i |
| Oliver Pell Control Ltd. | Cover iii |
| Perry & Hope Ltd. | 396 |
| Pharmaceutical Laboratories Geigy, Ltd. | x |
| Podmore, W., & Sons Ltd. | 396 |
| Premier Filterpress Co., Ltd., The | xix |
| Spence, Peter, & Sons Ltd. | xvi |
| T. & T. Works Ltd. | xix |
| Thermal Syndicate Ltd., The | xi |
| Towers, J. W., & Co., Ltd. | i |
| Unifloc Reagents Ltd. | xviii |
| Walker, James, & Co., Ltd. | Cover iv |
| Watford Chemical Co., Ltd., The | viii |
| Widnes Foundry & Engineering Co., Ltd. | xiii |



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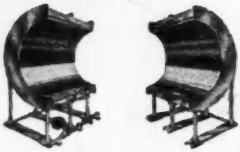

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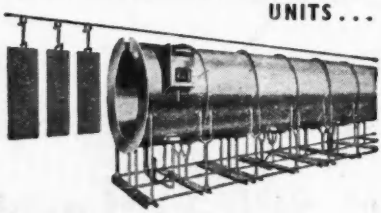

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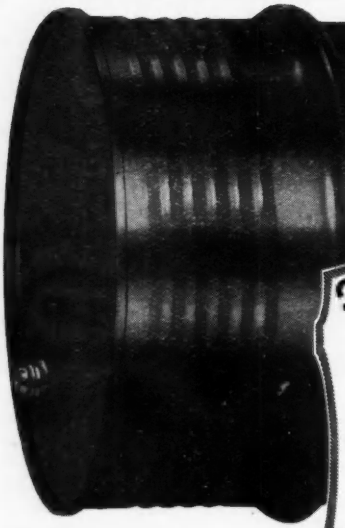

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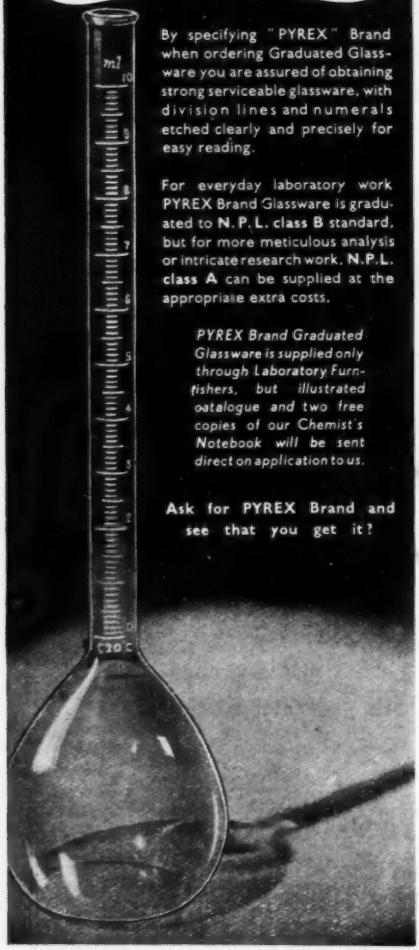

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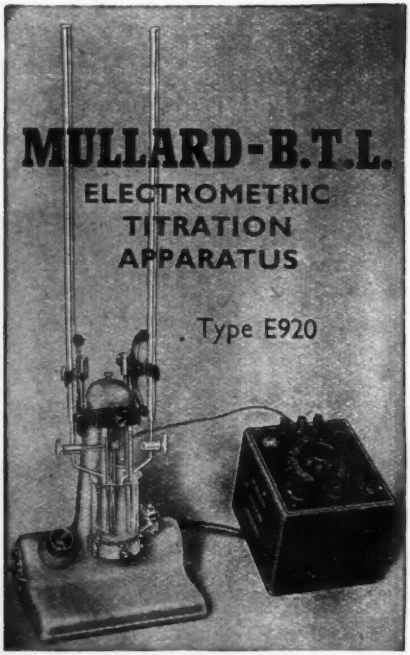


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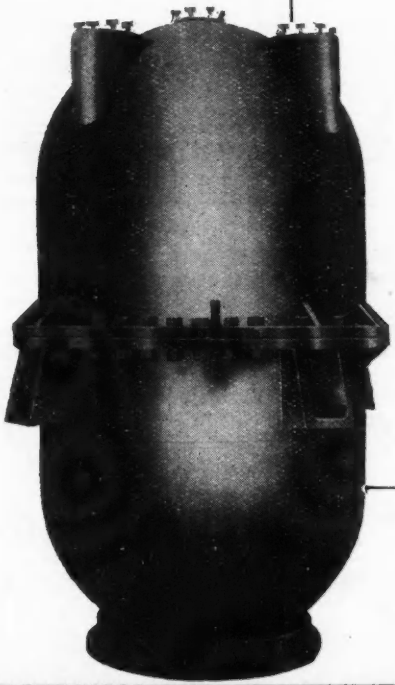

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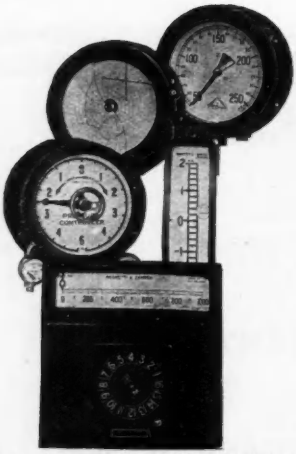

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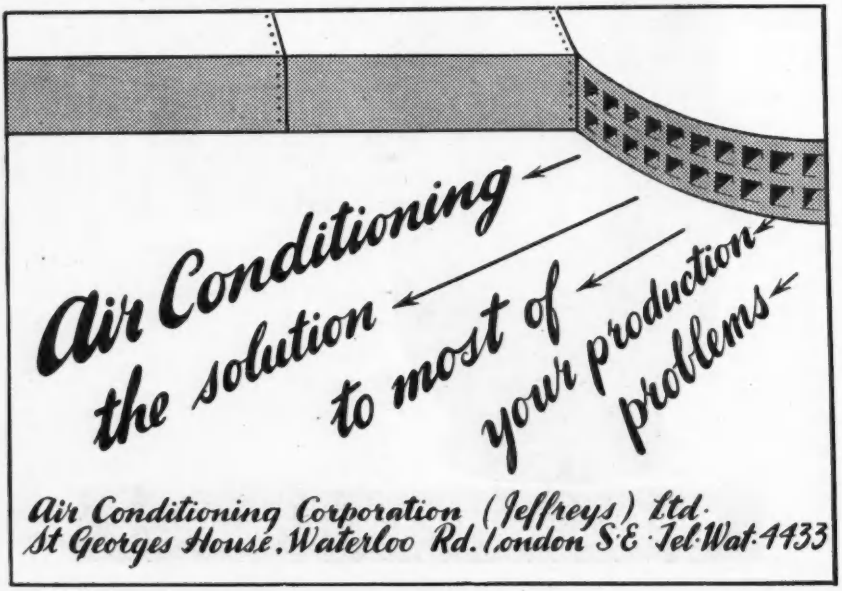

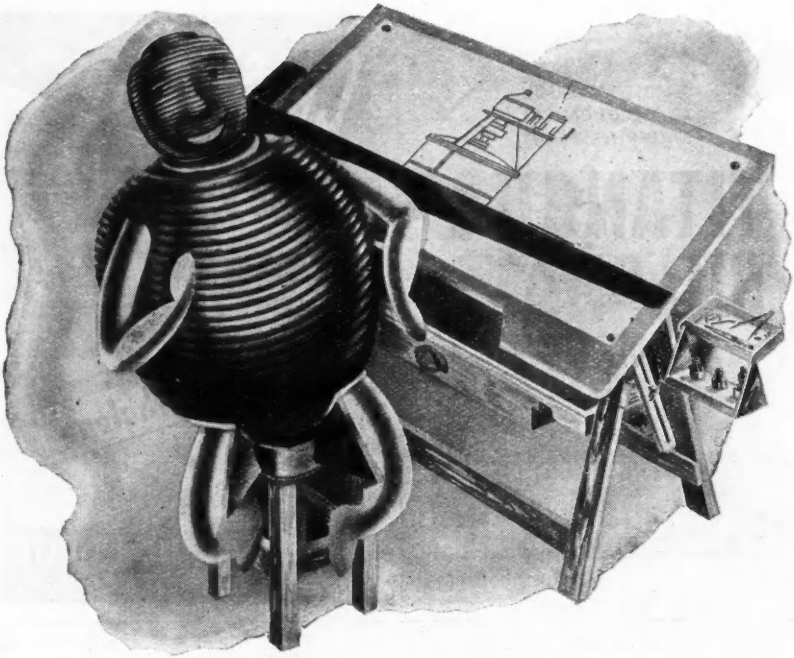

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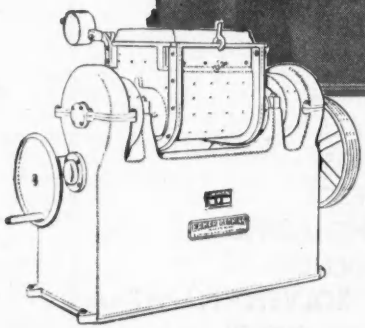

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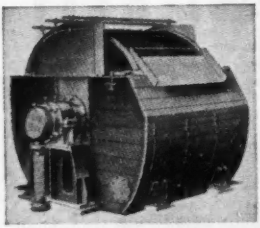

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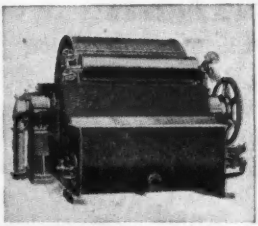

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# Mine Oyster

FROM time to time during the past few years we have discoursed in these columns, pleasantly perhaps but to little effect, upon the need for the British chemical industry and chemical plant industry to be internationally minded and to take their rightful place in the international field. We have, through Imperial Chemical Industries, Ltd., and other organisations in slightly different spheres, bodies which can and do uphold the prestige of this country in their particular fields. The value of the concept of the late Lord Melchett can now be seen, especially in the international field. There, however much we may speak of collaboration and Atlantic Charters and U.N.O., the basic principle is and is likely to remain that only equals will deal with equals. It can hardly be expected that a nation, having developed a really strong industry, will willingly surrender a material part of its foreign business or home market to some nation that is not so developed in that industry and that has no organisation that is sufficiently strong to command respect. In industry as in war, victory goes to those who have the power.

In the field of chemical plant, we find ourselves without great chemical engineering firms of the size and ramifications of those of America and those formerly existing in Germany. There is no need to labour the difficulties which handicapped this country in the international field in chemical plant manufacture. For many reasons, the German chemical plant industry secured a name for itself and a reputation for skill that was not ill-deserved. British chemical plant manufacturers were the equals of the Germans in skill and in knowledge, but not in experience nor in their command of the technique of different processes. Some day there may be issued a BIOS report setting forth the inter-relationship between the German chemical industry and the German chemical plant industry. Whatever may be the reason, it was the fact that before the war the Germans were able to offer with expert knowledge plant covering a range of chemical processes that we could not parallel.

There is always the fundamental difficulty that a plant manufacturer cannot afford to maintain the necessary staff to keep himself fully abreast of every development in all branches of chemical industry. The best he can do is to carry a staff that can collaborate with the purchasers of plant in solving new problems. In certain lines of development, where there

## On Other Pages

| | |
|---|---|
| *Solid and Liquid Propellants* ... | 367 |
| *Chemical Exports in February* ... | 375 |
| *Selection of Boiler Plant* ... | 376 |
| *New Detergent Powder* ... | 378 |
| *Coal Figures* ... ... ... | 379 |
| *Quest for Power Units* ... ... | 379 |
| *44-Hour Week* ... ... ... | 379 |
| *Fire-proofing of Fabrics* ... | 380 |
| *Chemists Honoured* ... ... | 381 |
| *Oil Prices Increased* ... ... | 382 |
| *U.S. Chemical Profits* ... ... | 382 |
| *Chemist's Bookshelf* ... ... | 383 |
| *German Technical Reports* ... | 384 |
| *The Chemical Society* ... ... | 384 |
| *American Chemical Notebook* ... | 385 |
| *Glasses for the Laboratory* ... | 386 |
| *Home News Items* ... ... | 389 |
| *Parliamentary Topics* ... ... | 390 |
| *Overseas News Items* ... ... | 391 |
| *Personal and Obituary* ... ... | 392 |
| *Company News* ... ... ... | 393 |

is need for repeated new installations of a similar character, as in by-product coking or sulphuric acid manufacture, the plant builder can and does succeed in keeping ahead of the rest of the industry so that he is the ultimate authority on what is good practice. That is rarely possible in the chemical industry and it seems that the success of the German chemical plant makers lay in their collaboration with chemical manufacturers. In the absence of authoritative reports, we advance this theory with a certain diffidence; the facts may never be known.

Whatever may be the way in which these things were done in Germany, the fact remains that many British chemical plant manufacturers, both now and before the war, could have built the necessary plant, had they not been limited in their knowledge of process design. Moreover, their contact with foreign buyers was not as close as it should have been, and the result was that these consumer nations sent their inquiries to Germany or America rather than to this country. When inquiries were obtained, the British firm first had great difficulty in separating the wheat from the chaff, and, second, there was the difficulty of securing a design. To pay a consultant's fee would often have overloaded the cost of the job; even consultants cannot work " on spec," so that the employment of a consultant to draw up designs for projects that never came to fruition would have proved impossibly expensive.

With the collapse of Germany, the path has been thrown open to the British chemical and chemical plant industry to seek and secure foreign markets. It is of no use " cashing-in " on the present advantageous situation just by accepting the orders that are rolling in and taking no further steps to consolidate the position. Already some British manufacturers are expressing concern as to the future productive capacity of Germany for chemicals. Germany must live and the German chemical industry will revive. The essential is that Britain should be ready and able to take her place in the international field as a supplier of chemicals and chemical plant, not only by reason of the temporary world shortage, not only by reason of the temporary eclipse of Germany, but in her own right as one of the great chemical engineering nations of the world. " The world's mine oyster, which I with sword will open," declared Pistol. We do not to-day propose to use a sword for that purpose—though the cynic might hint that we have done so in two recent world wars. Our basic problem is how to open this oyster that may be ready for us.

The solution is perhaps not so far to seek as it might appear. Certain principles are evident. A strong chemical industry, wide ramifications of both chemical and chemical plant industry throughout the world, an advisory service to coordinate the two with the foreign consumer. These are some of the essentials.

There is, however, another important step that can be taken. It is undeniable that, as more and more of the nations of the world become industrialised, they will manufacture their basic requirements. Britain must live by " knowing how." Our engineers, chemists and industrialists must keep a jump ahead of everyone else. We shall earn our livelihood by our superior skill in manufacture and by our superior knowledge. The nations of the world must look to us for advice. We have no " corner " in knowledge. But if we can set up an organisation which will achieve world-wide fame and confidence, we shall at least get our share of world inquiries and world trade. Home manufacturers, too, will need assistance in preparing designs, and in running their own works. Chemical manufacturers, for example, use a great deal of fuel; are they sure that their works are laid out to the best advantage and that their production costs are down to the minimum?

Much is being done quietly and behind the scenes to consolidate the foreign interests both of the British chemical industry and of the chemical plant industry. No doubt there will in due course be some public announcement of the steps that are being taken. There is, it has seemed to us, another essential measure that might be undertaken by the chemical manufacturers and chemical plant manufacturers in conjunction. Our suggestion is the formation of a strong consultative advisory service. Would-be manufacturers of chemicals abroad are in need of disinterested advice and it may be that such an organisation could link the foreign producer with British works. In addition the overdue development of the great resources of the Empire might well be undertaken by British manufacturers.

# NOTES AND COMMENTS

## Adverse Trade Wind

FREQUENT warnings during the past six months that British exporters could not hope much longer to enjoy the privileges of operating in a " sellers' market " are brought home in a form which can no longer be ignored in the figures just issued of United Kingdom overseas trade in February. Our entire exports during that month were valued at £76 million, £15.2 million less than the previous month and substantially lower than any month since September last. The possibility that this shrinking trade was the expected outcome of the recent industrial hold-up is, unfortunately, discounted by the Board of Trade. Because of the time lag in recording exports, says the Board, the effect of this factor is not yet apparent. Thus, making due allowance for the fact that February is a short month, it yet seems abundantly evident that limiting factors are now operating in the foreign markets which, together with the hold-up in production, must have a further depressing effect upon future returns. In our own field, heavy chemicals, which had in recent months made notable headway in many markets formerly supplied from other sources, are now reacting sharply to the easterly trend in the world's trade winds, as February's trading figure of £2.5 million compared with £3.3 million last year indicates. Mr. Oliver Lyttleton, not long ago, set the chemical industry the target of 235 per cent of 1938 export figure to fulfil this country's export drive. Unless there is an immediate improvement in the supply of fuel, power and raw materials and recognition that shorter hours and higher output are generally incompatible, Mr. Lyttleton's plan can only be another example of wishful talking.

## The Wage Race

ANY estimate of the sum of impediments with which industry in Britain has to contend must place very high in the list the competitive drive for wage increases. Shortages of fuel and of raw material can and must be remedied and even the labour force can be substantially supplemented by more means than one. But so long as production ranks a bad second in the scale of values in which shorter hours and larger pay packets dwarf all else the prospect of Britain's economic recovery will be thin indeed. That much is now admitted by all able to take a non-partisan view of the facts, including even some T.U. leaders but not, unfortunately, the Government, which still evades the issue of a national wages policy, or, in particular, the wage earners themselves. They still cling firmly to the illusion that money in itself can confer the benefits they want. On them for the moment, it is now being said, has fallen the mantle of the industrialist and property owner of the Victorian era. This is their golden age. They ask for much less than the plutocrats—a modest security in old age and a good living wage while they work. But when they number many millions, represent the bulk of the consumers and obtain increases in wages on as rapid a scale as in the last seven years (wage rates + 65 per cent and actual earnings approximately + 90 per cent) there must be a corresponding rise in the cost of living. Unless this rise can be stopped, the workers, by demanding further increases in wages will only be chasing a will-o'-the-wisp.

## " Points " Rating

WITHOUT a national wages policy economic catastrophe may be inevitable. Among those who, in recognition of this, have been studying the prospects for a plan for the overall regulation of wages is Mr. C. A. Lidbury, to whose detailed examination of the problems of the present wage race and their cure the *Industrial Law Review* devotes the whole of its last issue. Since—as he says—the time has not yet come when we shall all dine at the Ritz and the dishes will wash themselves up, incentives to greater production are the prime necessity. A modification of P.A.Y.E. to encourage overtime and various psychological incentives, such as shortened hours in return for greater effort, are among his recommendations, and his main solution of the wages spiral is the adoption by the whole of industry of " Points Rating," which is now being studied as a means of providing a common denominator for wages in all departments of industry. Basically, it urges that all industrial operations should be reviewed on a common basis and points awarded for degrees of skill, training, res-

ponsibility, discomfort and a host of kindred factors. Therein lies the ultimate weakness of the system—in the complexity which calls, in the most summary assessment, for 17 main sections of criteria and four others—" fumes, dust, noise, wet "—averaging 12 sub-divisions each. The need to call a halt to the competing claims between industry and industry, of which the demand by the railway unions for "£1 (or better) all round " is the latest manifestation, is self evident. But Points Rating, which seems calculated to produce yet another bargaining offensive worse than the last, is not likely to provide the way.

## Damages and Income Tax

AN interesting point as to the assessment of damages for loss of wages arose recently. The defendant in an action was held to be liable to the plaintiff for causing him personal injuries. But, said the defendant, I am only liable to pay him what he would have earned, after deduction of income tax. This, and not his gross wages, is the true measure of his loss. However, Mr. Justice Atkinson, sitting in the Commercial Court, decided otherwise. He said that the true way of looking at it was to ascertain what the plaintiffs contractual rights against his employers were. The plaintiff was entitled to a certain sum per week, and the mere fact that a part of that sum would have gone to the Inland Revenue did not affect the amouunt of his wages. If the Inland Revenue authorities considered that they were entitled to a part of the amount awarded to the plaintiff as damages, that was a matter for them.

## Chemical Glassware

THAT no workman is competent who does not know the capabilities and limitations of his tools is possibly a truism, but, like many other truisms, it enshrines a fact which is commonly overlooked. The force of the saying when it is applied to the scientific worker is even greater. With this in view THE CHEMICAL AGE publishes this week the first article of a series which will provide a study of chemical glassware, its design and production, including particularly the wide field of scientific glass-blowing. These articles will deal as fully as possible with the many problems met by those who make apparatus, whether in the glass works or as glass-blowers in chemical laboratories, or as industrial chemists. It is very evident that the number of persons in one or other branch of the chemical industry who will welcome all the information they can get affecting the characteristics of various glasses and the design of apparatus is extremely large, and that sources of information have hitherto been few and meagre. In fulfilling their principal object of describing new or little known methods of working glass and collating and presenting essential data about plant and materials, these articles will perform a secondary rôle of no less importance—by familiarising the chemist and the manufacturer with each other's views and problems they will facilitate improvement in design of chemical glassware, and by encouraging the scientific approach help to put an end to the " hit and miss " method. That this has prevailed too long and that quality of a good deal of the apparatus now being made is still capable of great improvement . . . is another truism.

## U.S. CHEMISTRY SCHOLARSHIPS

Ten chemistry scholarships for scholars, chemists and chemical engineers, total value $25,000, are being offered by the American Chemical Society, for which preliminary selection of candidates will be made by Unesco (Dr. Joseph Needham, Section of Natural Sciences, 19 Avenue Kleber, Paris). Candidates, after completing their studies in the U.S.A., will be required to spend a further two years studying in their own countries. Further schemes for promoting educational, scientific and cultural activities, principally in war devastated countries, are to be provided for by an international fund of approximately £25 million.

**Professor Peptic:** ***I said litre !***

# SOLID AND LIQUID PROPELLANTS*

by W. H. WHEELER, M.A., D.I.C., Ph.D.,†
H. WHITTAKER, M.Sc.,† and H. M. PIKE, B.Sc., Ph.D.†

THE term "propellant" as ordinarily understood is self-explanatory, even though typical propellants are frequently used to achieve other objects than propulsion. The oldest propellant is gunpowder, discovered by the Chinese about 2000 years ago.

Its characteristic property, as for all self-contained or mono-propellants, is that it comprises both combustible and oxidant in sufficiently intimate association to ensure rapid combination without the aid of atmospheric oxygen, with evolution of heat and the generation of a considerable volume of gaseous products. It is obviously desirable, and generally essential, that a propellant should be stable and relatively permanent, under normal conditions of storage, and that it should not be prone to detonation. As a rule initiation of the characteristic reaction is achieved by the application of heat and, once initiated, the reaction usually proceeds to completion.

## Common Usages

The common usages of propellants, in rifle and pistol cartridges, gun charges, and signal and life-saving rockets, have all been such as to demand the utmost simplicity and convenience for large-scale manufacture and handling. In all these applications this insistence on simplicity has encouraged the use of solid propellants; only during the last few years has attention been turned to the development of systems capable of benefiting by the employment of propellants in liquid form. Outstanding among these newer developments is the rocket motor, either in conventional form as a thrust unit or, more recently, as a pressure-gas generator.

The reaction which occurs when a solid propellant burns always takes place on the surface of the charge. The heat which is applied to initiate burning raises the exposed surfaces to a temperature such that vigorous reaction occurs between the combining elements. The products of the reaction are gaseous, and leave a newly exposed surface free to continue the reaction. If, for any reason, the reaction is so slow that insufficient heat is returned to the new surface to maintain the necessary level of activity, combustion dies out. This may occur, for example, in a cordite rocket chilled to a low temperature, where the loss of heat to the tube walls is so great in the early stages that, although once initiated, combustion may fail.

It is the fact that combustion occurs on the exposed surfaces which leads to the characteristic differences between solid and liquid propellant systems. With solid propellants the rate of burning at any stage is predetermined by the original geometric shape of the charge, and to vary the thrust at will, or to stop and re-start, are problems involving major difficulties. Only in cases where the requisite variations are to be repetitive from one unit to another is it convenient, and with present technique possible, to arrange for controlled variations in the rate of burning of solid propellant rockets. With liquid propellants the situation is different: the fuel feed to the combustion chamber can be varied or stopped and, provided ignition arrangements are adequate, thrust can be re-started as and when desired.

However, this does not state the whole of the problem. For satisfactory combustion a reasonably high chamber pressure is required: theoretically, rocket motor performance increases continuously with increasing chamber pressure, although at a declining rate as the pressure rises.

Weight is the outstanding restrictive factor in the design of rocket motors, but there are others, different for solid and liquid types, which lead to preferences for one or the other according to the task to be performed.

## Differing Factors

With liquid propellants a large fraction of the time spent by an element of fuel in the combustion chamber is occupied in atomisation, heating, evaporation, turbulent mixing and inter-diffusion. Not only is time required to effect these preliminaries, but also combustion chamber space, and it follows that the total combustion space needed is often large compared with actual combustion requirements. With solid fuels all the mixing is already done; burning takes place on the surface of the charge and relatively little combustion space is needed. One consequence of these differing circumstances is that in cases where the time of burning is short—that is, where the ratio of thrust to total impulse is large—solid fuel systems are likely to be preferred.

At the other extreme, where the time of burning is long, liquid fuel systems usually have the advantage, particularly if pump feed to the combustion chamber can be employed. In such cases, as the period of

* From a paper presented to the Institute of Fuel on February 5.
† of the Ministry of Supply.

burning is extended, only the fuel and fuel containers need to be increased. The pumps, turbine, combustion chamber and venturi all remain unaltered in size and weight, and they represent a continuously decreasing fraction of the weight of the unit as a whole. The corollary, that the ratio $\frac{\textit{fuel weight}}{\textit{total weight}}$ is increased, satisfies one of the most important precepts of rocket motor design.

For high performance, the temperature in the combustion chamber must be high, and in practice it is frequently in the region of 5000° Rankine. There are obvious attractions, in these circumstances, in liquid cooling of the combustion chamber and venturi, and it has been found practicable to employ several liquid propellants as coolants, circulated round the chamber before injection and combustion. This facility is not available with solid propellants.

The liquids used as rocket fuels are, in many cases, unstable or corrosive and these factors introduce special difficulties in the construction of fuel tranks and valves and sometimes preclude long period storage. Solid propellants, on the other hand, are relatively stable, providing contact with incompatible materials is avoided.

The outstanding attractions of solid-fuel systems are their simplicity and relative cheapness, combined with extreme reliability. The novelty of liquid-fuel rocket motor technique and general working familiarity with several of the substances used as liquid propellants are factors liable to screen these advantages of the older, but less generally understood, solid-fuel types.

## Solid Propellants

During the recent war, research and development on the production, properties and use of solid propellants for rocket propulsion were carried on extensively in this country and in the U.S.A. Investigations in Germany since the end of the war have likewise revealed intensive research on the subject, although overshadowed to some extent by their work on liquid propellants.

In this country one of the rocket propellants was a ready development from one previously developed for guns. It fell into the broad class known as "double-base" propellants, based on a liquid nitric ester (normally nitro-glycerine) and a solid nitric ester, nitrocellulose. Manufacture was by a solventless process and the gelatinisation of the nitrocellulose by the nitroglycerine was effected by the use of diethyl diphenyl urea, normally known as carbamite. This compound not only acts as a gelatiniser, but it has also remarkable stabilising properties, neutralising the decomposition products of nitric esters and thus greatly prolonging the useful life of the propellant.

The ingredients are: nitroglycerine, 50 parts by weight; nitrocellulose, 41 parts by weight; carbamite, 9 parts by weight.

The solid (colloid) rocket cordite used by Germany was very similar to that described above. The chief difference lay in their use, to a great extent, of the liquid nitric ester diethylene glycol dinitrate instead of ntiroglycerine. This can largely be ascribed to supply conditions. Nitroglycerine requires glycerine which is derived from fats, of which Germany was extremely short, while on the other hand they had well established industries for the isolation and use of ethylene. Nevertheless, it would be unfair not to admit that diethylene glycol dinitrate possesses some advantages over nitroglycerine. In particular it is much less sensitive and hence safer to handle, and it is also a better gelatiniser of nitrocellulose.

## Plastic Propellants

Important developments have also been made in the evolution of plastic propellants which can be filled direct into the rocket tube. Such propellants, as manufactured, are of the consistency of plasticine, are not thermosetting and retain their plastic properties through their life.

In general, plastic propellants are based on up to 90 per cent of solid ingredients milled with a binder to give the required degree of plasticity. The binder may be a solution of low nitrogen, low viscosity nitrocellulose in diethylene glycol dinitrate plus carbamite; instead of diethylene glycol dinitrate, nitroglycerine phlegmatised with dibutyl phthalate may be used.

A wide variety of compositions, all acceptably plastic, is possible, whereby the functioning (performance index, rate of burning, etc.) can be readily controlled. An important advantage may accrue in the use of plastic propellants for the filling of rocket tubes, etc., of very wide diameter. The plant requirements and the method of manufacture are somewhat simpler than for rocket cordite.

Nitroglycerine and nitrocellulose are still being used in experimental propellants, but in smaller quantities than for the established double-base propellant, in compositions containing, in addition, substantial amounts of nitrates or perchlorates and carbonaceous material.

Considerable development has taken place, particularly in the U.S.A., in the preparation and use of a solid propellant consisting of a mixture of finely ground potassium perchlorate, well dispersed in hot asphalt. Such a fuel mixture had the advantage that it could be cast in the rocket tube or motor. Thermo-setting resins were also used as bases for the incorporation of finely milled solid ingredients.

Both pressed and cast charges, based largely on ammonium nitrate with additives

such as ammonium dichromate as the fuel, have been developed in this country. The pressed charge, in particular, is relatively simple to manufacture and very safe to handle and its use for a variety of purposes is assured.

Mention may be made of a cast propellant (Giessling Pulver) developed in Germany, of which the composition was:

| | Parts |
|---|---|
| Trinitrotoluene ... ... ... ... ... | 50 |
| Diethylene glycol dinitrate ... ... ... | 17-18 |
| Nitrocellulose (nitrogen content 12.2 per cent) | 28-29 |
| Diphenylamine ... ... ... ... ... | 0.5 |
| Carbamite ... ... ... ... ... | 0.5 |

In manufacture a paste of the nitrocellulose and diethylene glycol dinitrate plus stabilisers is made and, while still moist, is crumbled and added slowly to the molten T.N.T. which is kept well stirred. Water and air are removed by vacuum and the molten charge is run into steel moulds and cooled for 24 to 48 hours under controlled conditions. Charges up to 40-in. long and 21-in. diameter were manufactured experimentally.

## Liquid Propellants

German interest, pre-war, in such devices as long-range rockets, high speed aeroplane (rocket) fighters, guided missiles, fast torpedoes and submarines, inevitably led to their earlier entry into the field of liquid propulsion and to great concentration of effort.

Among the code-names used by the Germans for some monopropellants are *Monergols*: fuel systems based on a single fluid which decomposes on ignition, the latter supplied by a small cordite charge or a pyrotechnic device. The mixture of methyl nitrate and methanol (Myrol) is typical.

*Katergols*: fuel systems based on a single fluid which is decomposed catalytically, either a liquid or solid catalyst being used. The best known example is concentrated (approximately 80 per cent) hydrogen peroxide, the catalyst being a solution of calcium (or sodium) permanganate or a solid impregnated with active chemical compounds, *e.g.*, permanganates, chromates, dichromates, manganese oxides, etc., either alone or, more usually, mixed.

*Lithergols*: fuel systems with one component liquid, the other solid and situated in the combustion chamber. For example, rocket units were developed which burned particles of a solid fuel with liquid oxygen as oxidant. The carbon was first supported by screens in the combustion chamber and was later made into the form of perforated discs which filled the combustion chamber.

Among the bipropellants are *Diergols*: fuel systems based on two liquids, an oxidant and a fuel, which are not self-igniting on mixing, and require an ignition device similar to that used with monergols in order to start combustion. Liquid oxygen and ethanol may be mentioned.

*Hypergols*: fuel systems based on two liquids, an oxidant and a fuel which are self-igniting on mixing. Concentrated nitric acid with aniline, or concentrated hydrogen peroxide with a mixture of hydrazine hydrate and methanol are typical of such systems.

The term "monopropellant is not necessarily synonymous with a single liquid compound; on the contrary, monopropellants, particularly for useful high thrusts (say specific impulses greater than 140) are likely to consist of a mixture of liquids. In the "bipropellant" field, especially those based on hydrogen peroxide as the oxidant, systems are likely to be investigated in which three liquids are used (*see* Table I).

## Examples of Monopropellants

At the end of the war the only established monopropellant was concentrated hydrogen peroxide (80 to 85 per cent $H_2O_2$), decomposition of which into steam and oxygen was effected by a liquid catalyst (concentrated solution of calcium or sodium permanganate). Three German examples of its use may be quoted:

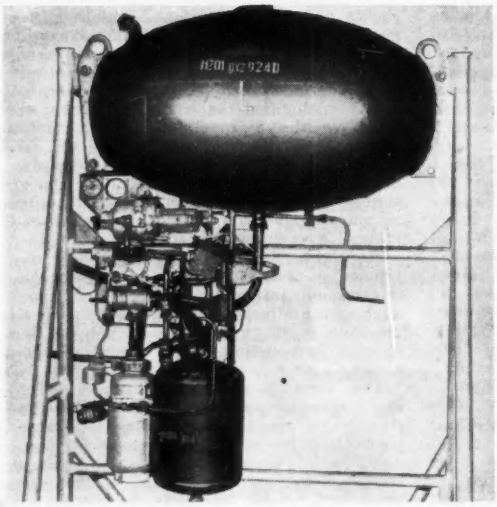
(a) The glider rocket bomb designated Hs 293; (b) the catapult launching device for the V1; and (c) the turbine driven pump system of the V2 for delivery of the main fuel charges to the combustion chamber.

On the experimental side of monopropellants, the use of a solid catalyst with hydrogen peroxide is a very promising alternative to the use of permanganate solutions. There are obvious advantages in ease of transport and storage, and the elimination of pumps

TABLE I

"ESTABLISHED" BIPROPELLANT SYSTEMS

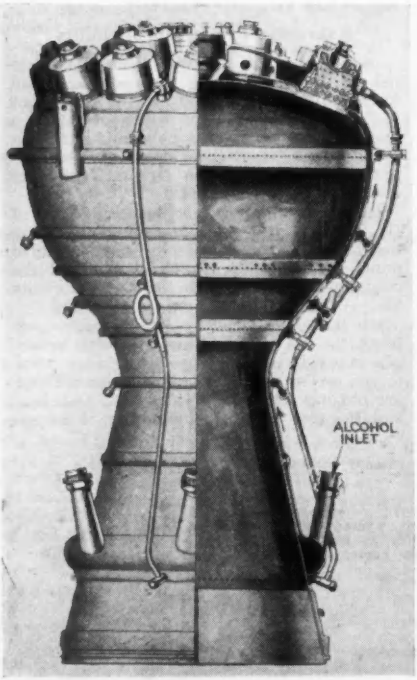
| Oxidant | Fuel | Application |
|---|---|---|
| 1. Liquid oxygen ... ... ... | Ethanol (with water) | German V2. |
| 2. Hydrogen peroxide ... ... ... | Mixture of hydrazine hydrate and methanol containing as ignition catalyst potassium cuprocyanide | German Me. 163 b. |
| 3. Hydrogen peroxide (decomposed by liquid catalyst) | Petrol | German "Hot" A.T.O. unit |
| 4. Hydrogen peroxide (decomposed by liquid catalyst) | Dekalin | German torpedoes. |
| 5. Concentrated nitric acid + nitrogen tetroxide (with oleum) ... ... | Aniline or dimethylaniline | A.T.O. units (U.S.A.) |
| 6. Concentrated nitric acid + sulphuric acid | Vinyl ethers + pyrocatechol | German guided A.A. projectile "Wasserfall" and U.S.A. |

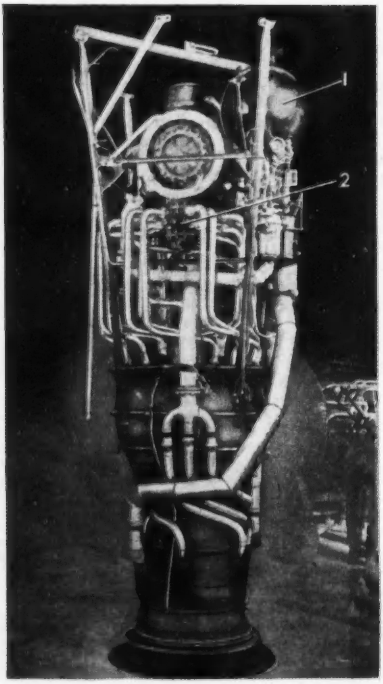


Photographs of parts of the German A-4 rocket (V2), which is comparable from the point of view of complexity of construction and cost (£1 per 1 lb. net weight) with a fighter aeroplane.

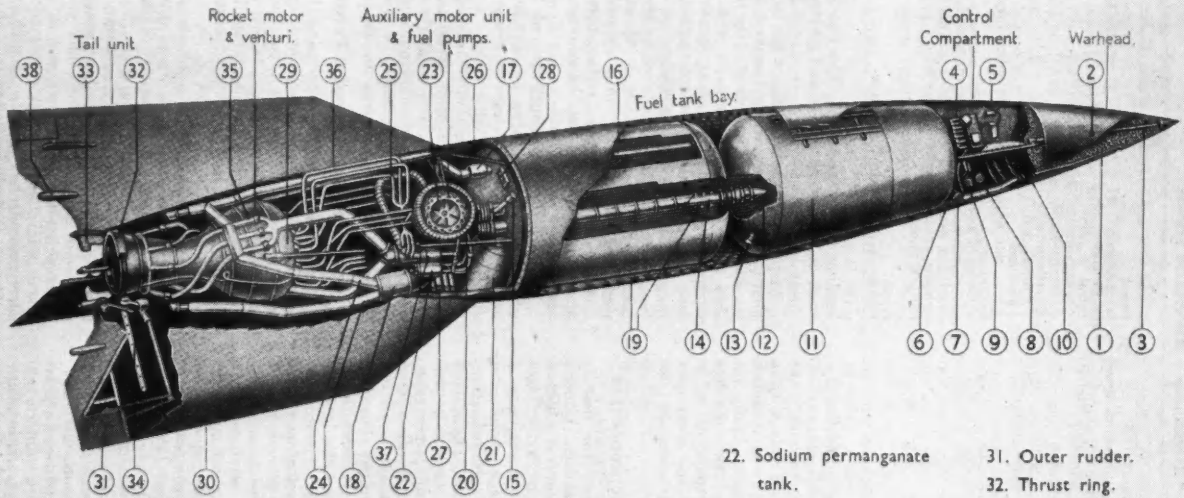
Top : Hydrogen peroxide steam generator which delivered super-heated steam to a 600 h.p. turbine to drive two fuel pumps.

Bottom, left : Combustion chamber which was cooled by the liquid propellant (alcohol) which entered at the marked inlet and flowed between the inner and outer wall of the chamber. Bottom, right : Propulsion assembly, showing the steam generator (1) and the main oxygen control valve (2) from which aluminium pipes led the oxygen to the combustion chamber



# GERMAN LONG-RANGE A-4 ROCKET.


Tail unit
Rocket motor & venturi.
Auxiliary motor unit & fuel pumps.
Control Compartment
Warhead.
Fuel tank bay.
38 33 32 35 29 36 25 23 26 17 28 16 4 5 2
19 14 13 12 11 6 7 9 8 10 1 3
31 34 30 24 18 37 22 27 20 21 15

1. Alcohol tank pressurising pipe.
2. Slinging point.
3. Central exploder tube.
4. Main distribution box & ground control plug
5. Alternator & regulator.
6. Time switch.
7. Alcohol fuelling inlet.
8. Air pressure gauge & hand control cock.
9. Automatic pilot.
10. Control amplifier.
11. Alcohol tank.
12. Outlet valve.
13. Drainage valve.
14. Alcohol delivery pipe.
15. Oxygen fuelling inlet.
16. Stack pipe.
17. Oxygen tank vent valve.
18. Heat exchanger unit.
19. Glass wool.
20. Turbine.
21. Hydrogen peroxide tank.
22. Sodium permanganate tank.
23. Oxygen & alcohol pumps.
24. Turbine exhausts.
25. Oxygen main valve.
26. Braced steel frame.
27. Compressed air bottles.
28. Distribution box.
29. Combustion chamber.
30. Stabilising fin.
31. Outer rudder.
32. Thrust ring.
33. Carbon rudder.
34. Servo motor.
35. Alcohol feed pipes.
36. Oxygen feed pipes.
37. Auxiliary combustion chamber.
38. Aerial supports.

TABLE II

"EXPERIMENTAL" BIPROPELLANT SYSTEMS

| Oxidant | Fuel |
|---|---|
| 1. Liquid oxygen | Petrol |
| 2. Hydrogen peroxide (decomposed by liquid catalysts) | (*a*) Methanol<br>(*b*) Ethanol |
| 3. Hydrogen peroxide (decomposed by solid catalyst) | Petrol |
| 4. Hydrogen peroxide | Methanol<br>Crotonaldehyde<br>Ferric nitrate |
| 5. Hydrogen peroxide | Pyrocatechol<br>Methanol<br>Iron salt of di-isobutyl naphthalene sulphonic acid |
| 6. Concentrated nitric acid | Furfural |
| 7. Concentrated nitric acid + ferric chloride | Mixtures of aromatic and aliphatic amines (*e.g.*, aniline methyl aniline, xylidine, with trimethylamine or triethylamine), in some cases with addition of hydrocarbons (benzene, xylene, octane mixture, etc.) |
| 8. Concentrated nitric acid<br>Sulphuric acid | Furfuryl alcohol |
| 9. Tetranitromethane | Petrol |
| 10. Nitrogen tetroxide | Various—generally as for nitric acid |

or compressed nitrogen for expulsion reduces complication and saves space. A large variety of such catalyst "stones" has been investigated in a general way with a view to finding those fitting such requirements as (a) high specific throughput, (b) long life, (c) rapid starting, and (d) low abrasion loss—although in some cases, a slight abrasion is tolerable and necessary to renew the surface and maintain the activity of the stones.

### Substances Used as Monopropellants

Other substances considered for use as monopropellants include methyl nitrate, nitromethane, nitroglycerine and diethylene glycol dinitrate. Of these, methyl nitrate and nitroglycerine are very sensitive and powerful explosives; diethylene glycol and nitromethane are somewhat less sensitive, and, except possibly for the last named, none is suitable in itself for direct use as a propellant. For storage and transport purposes, as well as for propulsion applications, the sensitivity or liability to detonation or explosion (rather than controlled burning) must be reduced. This can generally be achieved by the addition of a suitable inert miscible diluent. With methyl nitrate, additions of varying percentages of methanol have been investigated. The Germans, who used the name Myrol for such mixtures, claimed at one time that a mixture of 75 parts methyl nitrate and 25 parts methanol was likely to be an acceptable monopropellant. Some of their experiences in its handling and use, and their own later work, has confirmed what we already knew in this country that such a mixture remains, in fact, an explosive. (*see* Table II.)

As diluents for both nitroglycerine and diethylene glycol dinitrate, mono-nitro-benzene has been tried in proportions up to about 20 per cent, but smooth burning is not always attained and special precautions are necessary to avoid a flash-back from the combustion chamber to the storage tank, leading to an explosion. The use of esters such as dibutyl phthalate as a phlegmatising agent is also possible.

At present it seems that, of the substances mentioned above, nitromethane shows most promise as a monopropellant. By the addition to it of a few per cent of a suitable compound, which acts as an ignition catalyst and generally promotes smooth burning, satisfactory decomposition in a combustion chamber can be achieved under special conditions. In practice a short initial period of oxygen flow, in conjunction with a spark plug, is used to start combustion, after which the nitromethane plus ignition agent burns alone.

In the field of bipropellants, at least six systems may be included among the "established" class and have already found diverse uses.

The very large field of "experimental" bipropellants on which investigation is known to be active, can similarly best be surveyed by Table II showing ten typical systems. It is not possible, of course, to indicate the uses as given in Table I.

### Production of Hydrogen Peroxide

It is clear from the foregoing that the production of concentrated hydrogen peroxide is at present of very great importance in the field of liquid fuels, taking into account its use both as a monopropellant and as the oxidant in a number of bipropellant systems.

Hydrogen peroxide is normally made in concentrations up to 35 per cent $H_2O_2$ (weight-weight) for a variety of industrial bleaching purposes, pharmaceuticals, etc. The preparation of highly concentrated (up to 100 per cent $H_2O_2$) has been studied in a number of laboratories for many years, but its large-scale manufacture was not undertaken until 1935 when it was made at the Electrochemische Werke, Munich.

There are three main variants of the electrochemical method commonly used for the

manufacture of 35 per cent hydrogen peroxide.

(I) Ammonium bisulphate solution is electrolysed to give ammonium persulphate in solution

$$2NH_4HSO_4 = (NH_4)_2S_2O_8 + H_2.$$

Potassium bisulphate is added to this solution to precipitate potassium persulphate and to leave a solution of ammonium bisulphate which is purified and returned to the electrolytic cells.

$$(NH_4)_2S_2O_8 + KHSO_4 = K_2S_2O_8 + 2NH_4HSO_4$$

The potassium persulphate is separated in centrifugals, treated with sulphuric acid and steam distilled to give hydrogen peroxide vapour which is fractionated to 35 per cent strength.

$$K_2S_2O_8 + 2H_2O (+ H_2SO_4 = 2KHSO_4 + H_2O_2 (+H_2SO_4)$$

The residue of potassium bisulphate and sulphuric acid is crystallised to give potassium bisulphate for return to the precipitation stage and sulphuric acid for use in the distillation stage.

(II) Ammonium bisulphate solution is electrolysed in cells and a solution of ammonium persulphate is obtained from the anode compartment. The solution of persulphate is heated under reduced pressure and breaks down to give $H_2O_2$ vapour and a solution of ammonium bisulphate which, after making up as required, is recycled. The peroxide is obtained as a vapour, mixed with water vapour, at about 25 mm. pressure, and is condensed in a tower to yield 30 to 35 per cent $H_2O_2$ solution.

(III) Sulphuric acid is electrolysed to produce persulphuric acid, which is hydrolysed and distilled to give hydrogen peroxide vapour. The latter is fractionated to produce a 30 to 35 per cent $H_2O_2$ solution.

Process No. I above was largely used in Germany, No. III being used there to a much lesser extent: production in this country is based principally on No. II.

## German Process

An entirely different method of manufacture was investigated at the I.G. Works, Oppau, carried to the pilot plant scale (producing 5 tons of 20 per cent $H_2O_2$ solution per 24 hours) and plans drawn up for the production of 4000 tons per month of concentrated (80 to 85 per cent) peroxide.

The process was based on the use of 2-ethyl anthraquinone, and consisted essentially of the union of hydrogen and oxygen to form hydrogen peroxide, the ethyl anthraquinone acting as a carrier for the hydrogen. The principal stages in the process were as follows:

(1) Hydrogenation of the 2-ethyl anthraquinone to the corresponding quinhydrone in solution in a mixture of benzene and various secondary alcohols, and in presence of Raney nickel catalyst.

(2) Oxidation of the quinhydrone to reform the quinone and split off the hydrogen atom as hydrogen peroxide, by simple aeration with diluted oxygen.

(3) Extraction of the hydrogen peroxide from solution in the mixed benzene-secondary alcohol solvent with water.

(4) Purification and make-up of the working solution ready for return to the hydrogenator.

Mention may also be made of research on the direct union of hydrogen and oxygen using an electric discharge. Production on anything more than a laboratory scale has not been successful, however, because of a big consumption of electric power.

The dilute (20 to 35 per cent $H_2O_2$) requires to be concentrated for use as a rocket fuel or oxidant. The best conditions are probably those in which concentration is carried out by distillation in, say, two stages. In the first stage, the dilute peroxide is continuously treated to give $H_2O_2$ vapour of the same strength, which is then fractionated to 65-70 per cent strength. The latter is similarly treated, the vapour being again fractionated to yield the final product of 80-85 per cent $H_2O_2$. Such operations can very conveniently be carried out in climbing film evaporators leading to increased safety due to the relatively small bulk of peroxide being heated at any one time.

## Handling Concentrated Peroxide

As regards the problems of stabilisation, stability, storage and general safety in handling of concentrated peroxide, the following points should be noted.

Hydrogen peroxide, even when stored under ideal conditions, tends to lose strength gradually, slowly decomposing with evolution of oxygen. Various organic and inorganic stabilisers are known, the addition of which, usually in small quantities, inhibits such decomposition to a greater or less extent. Included among the inorganic stabilisers are phosphoric acid and its sodium salt, and sodium stannate, while much attention has been given to the use of hydroxyquinoline as an organic stabiliser. The choice of stabiliser is determined to some extent by the use to which the peroxide is to be put and its conditions of storage. For example, it is normally unsuitable to use with solid catalysts a peroxide specially stabilised with relatively large amounts of inorganic materials, because of the "poisoning" effect on the catalyst stones. Such a peroxide is, however, generally suitable for use with solutions of calcium or sodium permanganate.

For storage and transport, pure (99.5 per cent) aluminium tanks and wagons are used, the interiors preferably of smooth, bright finish, with special attention to the welds. Containers should be pickled before use, using cold 30 per cent nitric acid. Alterna-

tively, especially for smaller tanks, an anodising treatment using oxalic and sulphuric acids, followed by a coating of the inside with a thin film of paraffin wax is beneficial.

Under good conditions, well stabilised and suitably stored, concentrated peroxide should not lose more than 2 per cent strength in a year.

### Properties of Liquid Propellants

Some consideration may now be given to the general physical and explosive properties of a number of compounds relevant to their use as liquid propellants. For example, in calculating their theoretical performance, in terms of "Specific Impulse" and the temperature of combustion a knowledge of the calorific value of the fuel is essential. By calorific value is meant the heat of decomposition of the fuel in the absence of an oxidising atmosphere.

The calorific value of a number of pure compounds has been determined by a method which may be briefly described as follows:

The water equivalent of the calorimeter was determined by burning a known weight of cordite, the thermal properties of which were accurately known. Compounds and mixtures, having a calorific value of approximately 1000 cal. per gm. were burned and the total heat determined. Under the conditions used, the amounts of carbon, methane and ammonia found in the products were very small and hence reduce the corrections applied to the total heat to a minimum. The heat as measured was corrected for: (a) ammonia; (b) methane; (c) heat of solution; (d) air present in the bomb; (e) heat supplied by material, *e.g.*, cordite, used to ignite the charge.

The calorific value, general properties and ignited temperature of the following possible liquid propellants have been obtained: methyl alcohol, ethyl alcohol, nitromethane, 1-nitropropane, methyl nitrate, ethyl nitrate, *n*-propyl nitrate, nitroglycerol, glycol dinitrate, diethylene glycol dinitrate, hydrogen peroxide, 85 per cent.

Detailed calculations show that bi-propellant systems give higher efficiencies than mono-propellants. This is due partly to the wider choice of compositions and partly to the fact that in mono-propellants the oxygen and combustible atoms are linked to the same molecule, there being a consequent loss of heat in the formation of the chemical bond.

The more important combustible components listed in order of mass efficiency are ammonia, the paraffins and the alcohols, followed by aromatic compounds such as aniline. On a volume basis, ammonia maintains first place but is nearly equalled by paraffin when used with hydrogen peroxide. Aniline jumps up to second place in the list of fuels to be used with nitric acid because of its very high density.

On a mass basis we can place the more important oxidants in the order liquid oxygen, hydrogen peroxide, nitric acid and nitrous oxide. On a volume basis the low density of liquid oxygen reduces it to third place, hydrogen peroxide being first, and nitric acid second.

The products obtained from mono-propellants composed of nitrated organic liquids are the same as those from colloidal propellants, the later stages of the reaction, in the gaseous phase, probably being the same also. When hydrogen peroxide is the main component of a propellant system, however, the products consist mainly of steam and there may be excess oxygen and no CO or $H_2$.

For colloidal propellants and mono-propellants composed of nitrated organic liquids such as nitromethane or ethyl nitrate, the products consist almost entirely of the five gases $N_2$, $CO_2$, $CO$, $H_2O$ and $H_2$, the proportion of inflammable gases ($CO + H_2$) remaining being as high as 70 per cent in some cases. With bipropellant systems, the proportion of inflammable gas is often much lower and when hydrogen peroxide is used as a major component there may even be excess oxygen.

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The British fine chemical industry played as gallant and as vital a part in winning the war as any, and we are glad to see that Roche Products, Ltd., in an admirable booklet entitled "Roche in Wartime," has put on record the story of how a typical firm carried on through the fateful years. The Roche building at Welwyn Garden City was one of the "Keeps," officially chosen to be "held to the last man" when invasion threatened, and this booklet, well written and illustrated, relates most graphically how the entire personnel, in the midst of their labours in factory and laboratory to maintain essential production, threw themselves into the task of defence.

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**New Processing of Coal.**—The American Cynamid Co. has developed what is known as the "heavy-media separation process" for cleaning coal and separating slate and other refuse, which may soon be generally used in United States coal mines. Inferior coal, mixed with slate and other foreign substances, can thus be turned into high-grade coal, it is claimed. Raw coal is fed into a machine and carried into a huge cone filled with a heavy liquid made up of water and fine-ground magnetite—an iron ore found in New York, New Jersey and Pennsylvania. In this fluid the refuse sinks while the coal floats. The process is claimed to work on both anthracite or bituminous coal.

# Chemical Exports in February

## Less Than January

UNITED KINGDOM exports in February were at the lowest level they have reached since September, 1946. The total was £76.0 million, which is £15.2 million less than in January. The figure is, however, still 26 per cent better than the corresponding period in 1946 and February, as a short month, cannot be accurately compared with January. Taking into account the time lag in recording exports, the reduction, states the *Board of Trade Journal*, cannot properly be attributed to the closing down of some industrial firms by the fuel shortage, although transport and shipment delays caused by the bad weather may have contributed. Total exports of chemicals, drugs, dyes and colours were valued at £4,612,728, £670,789 less than in February, 1946; non-ferrous metals and manufactures were £2,516,966, £329,163 more than last year; and iron and steel and manufactures £5,423,263, a reduction of £574,209. Imports, totalling £112,535,523, were more than 40 per cent higher than last February, an increase of £33,101,938. Chemical imports were £60,058 less than in 1946, totalling £6,021,304

EXPORTS OF CHEMICALS

| | Feb., 1947 | Feb., 1946 |
|---|---|---|
| | Cwts. | Cwts. |
| Citric acid | 1,151 | 850 |
| Formic acid | 2,524 | 2,032 |
| Tartaric acid | 2,815 | 462 |
| | Tons | Tons |
| Ammonium sulphate | 27,222 | 22,392 |
| Ammonium nitrate | 5,278 | 13,010 |
| Chloride of lime | 32,452 | 87,886 |
| | Galls. | Galls. |
| Cresylic acid | 206,253 | 245,218 |
| Tar oil, creosote, anthracene oil, etc. | 296,297 | 101,583 |
| | Tons | Tons |
| Copper sulphate | 2,124 | 7,785 |
| | Cwts. | Cwts. |
| Glycerine | 3,996 | 24,867 |
| Lead acetate, litharge, etc. | 10,038 | 12,133 |
| | Tons | Tons |
| Salt | 6,126 | 14,756 |
| Sodium carbonate, soda ash, etc. | 80,733 | 380,457 |
| Caustic Soda | 125,132 | 339,794 |
| Sodium sulphate | 20,091 | 89,141 |
| **Total chemicals and manufactures, excluding drugs and dyes** | £ 2,511,819 | £ 3,323,620 |

IMPORTS OF CHEMICALS

| | Feb., 1947 | Feb., 1946 |
|---|---|---|
| | Tons | Tons |
| Ammonium phosphate | 1,655 | — |
| | Cwts. | Cwts. |
| Borax | 24,284 | — |
| Coal tar products | 4,041 | 1 |
| | tons | tons |
| Manufactured fertilisers | 16,431 | 20,000 |
| | Cwts. | Cwts. |
| Potassium chloride | 209,581 | 645,018 |
| Potassium sulphate | 30,330 | — |
| Sodium nitrate | 19,940 | — |
| **Total chemical manufactures, excluding drugs and dyestuffs** | £ 262,061 | £ 113,635 |

EXPORTS OF METALS

| | Tons | Tons |
|---|---|---|
| Iron and steel :— | | |
| Pig iron | 6,074 | 60 |
| Ferro-alloys, etc. | 2,021 | 5,440 |
| Bright steel bars | 1,952 | 4,003 |
| Other descriptions | 11,668 | 27,008 |
| Angles, sections, etc. | 6,686 | 12,716 |
| Plates and sheets ($\frac{1}{8}$ in. and over) | 9,392 | 30,239 |
| Tinned plates | 7,485 | 6,751 |
| **Total iron and steel and manufactures** | 131,917 | 186,018 |
| | Cwts. | Cwts. |
| Aluminium and alloys | 52,091 | 30,957 |
| Brass and copper alloys | 88,572 | 85,202 |
| | Tons | Tons |
| Copper | 4,825 | 7,542 |
| Tin | 281 | 584 |
| **Total non-ferrous metals and manufactures** | £ 2,516,966 | £ 2,187,803 |

IMPORTS OF METALS

| | Feb., 1947 | Feb., 1946 |
|---|---|---|
| | Tons | Tons |
| Iron and steel :— | | |
| Pig iron | 1,226 | 4,517 |
| Ferro-alloys | 4,974 | 2,072 |
| Ingots, other than alloy steel | 10,723 | 9,056 |
| Blooms, billets, slabs | 23,046 | 25,582 |
| **Total iron and steel and manufactures** | £ 47,012 | £ 44,690 |
| | Cwts. | Cwts. |
| Aluminium and alloys | 5,462 | 3,000 |
| Brass and copper alloys | 741 | 419 |
| | Tons | Tons |
| Electrolytic copper | 11,634 | 5,589 |
| Copper | 4,601 | 13,730 |
| Lead | 6,318 | 10,951 |
| **Total non-ferrous metals and manufactures** | £ 2,968,976 | £ 1,865,410 |

## Fertiliser Society Formed

THE Fertiliser Society is a recently-formed organisation which is to serve the interests of the various fertiliser manufacturers and distributors in Great Britain. Called together at the initiative of the Fertiliser Manufacturers' Association, representatives of the Basic Slag Producers' Association, British Sulphate of Ammonia Federation, Federation of Bone Users and Allied Trades, Ltd., and the Horticultural Fertilisers Association, unanimously agreed that a co-ordinating body should be formed as a medium for the discussion of scientific and technical aspects of the production and use of fertilisers and for the interchange of views and information. Valuable technical developments, the organisers anticipate, will be promoted by the closer contact between members of the industry under the auspices of the Society, membership of which will be confined chiefly to those engaged in the manufacture of fertilisers, with an annual subscription of one guinea.

# Selection of Boiler Plant for Chemical Works

EXPERIENCE gained over many years has led to the development of water tube boilers of capacity ranges suitable for all branches of industry.

The majority of industrial plants operate at pressures within the 250-400 lb. limit, but the chemical industry is an exception in that for certain processes pressures as high as 900 lb. per sq. in. are required. The provision of boiler plant to fill these requirements provides no difficulty to the boiler designer. The construction of such plants and their maintenance provide no greater problems than are experienced in the design of boilers operating at much lower pressures.

## Constructional Details

The boiler constructional details follow the normal practice incorporated in British standard specifications and the temperature range is such that, except for the joint bolts on superheated steampipe flanges, alloy steels are not required. For refractory purposes high alumina bricks (40 per cent plus) are used in the hot zones of the combustion chamber and medium alumina (40 per cent minus) for the cooler areas. Bricks of diatomaceous earth are fitted behind refractory walls of a thickness sufficient to give a suitable casing temperature. When fin tubes are used for the furnace lining the refractory thickness is not so great and refractory concrete, backed by insulating material, is normally used.

Two typical examples of installations of chemical works may be quoted. Firstly, a Lopulco generator operating at 800 lb. per sq. in. at a steam temperature of 840° F., which has an evaporation capacity of 26,900 lb./hr. This plant uses pulverised fuel for firing. The second installation is a La Mont forced circulation boiler fired by coal and coke on the sandwich system by means of a louvre stoker. This plant gives 800 lb. per sq. in. at a temperature of 780° F. and a normal evaporation of 60,000 lb./hr. with a maximum capacity of 85,000 lb./hr.

A type of boiler which is likely to be widely adopted in this country, as it has already been in the United States, is the vertical two-drum boiler. This design has an advantage that all heating surfaces are concentrated. A cross flow of gases over the tube banks ensures that maximum heat transfer is achieved. The superheater incorporated may be of either the pendant or self-draining type according to the wish of the user. Economiser and/or air heater can be incorporated according to the efficiency desired. There is no limitation on the design of the combustion chamber as this is built on the side of the boiler to the required proportions; it is entirely water cooled, the cooling system being in circulation with the boiler. The resultant freedom in furnace design ensures that the very best use can be made of the method of firing adopted. As the whole of the boiler and combustion chamber is steel cased, and the supporting structure and casing is of homogeneous design, protection is offered against air infiltration.

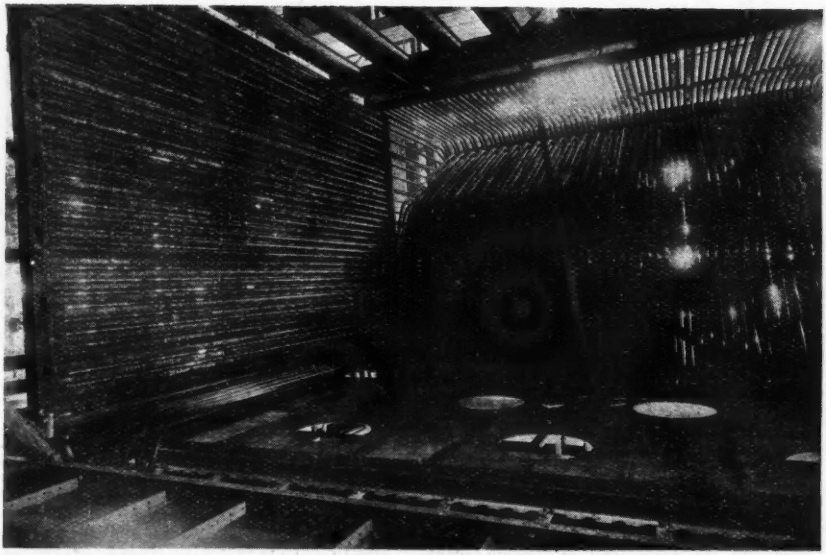
The method of firing adopted for industrial boiler plant is largely dependent upon the type of fuel available, but for all except the smallest boilers the pulverised fuel system of firing has many advantages including increased availability. In the unit system of firing, a mill is provided for each furnace together with the necessary standby units according to the length of plant outage periods. The modern mill is of the medium speed roller type. The fuel burners, which are mounted in the furnace side walls, are usually of the short flame type for industrial work, but for larger installations, particularly if the normal fuel is low in volatile content, corner firing is more suitable.

## Use of By-Products

Certain industries are able to use by-products such as blast furnace gas or reverberatory furnace gas for firing purposes, but it is necessary when these are used to have pulverised fuel firing as well, particularly for periods when by-products are not available.

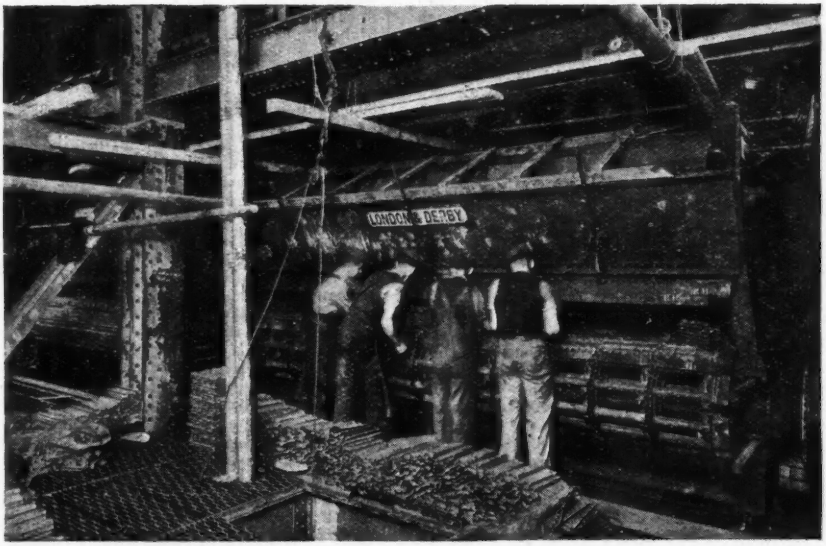
As a special case, from the fuelling standpoint, the installation at an oil refinery may be quoted. In this plant a two-drum boiler with a working pressure of 410 lb. per sq. in. and evaporation capacity of 7000 lb./hr. is provided with automatic oil firing. There is a closed circuit for process steam—as the firing is automatic the boiler is unattended. For most industrial installations, however, such convenient fuel supplies are not available and firing equipment capable of handling low-grade fuels efficiently have to be considered.

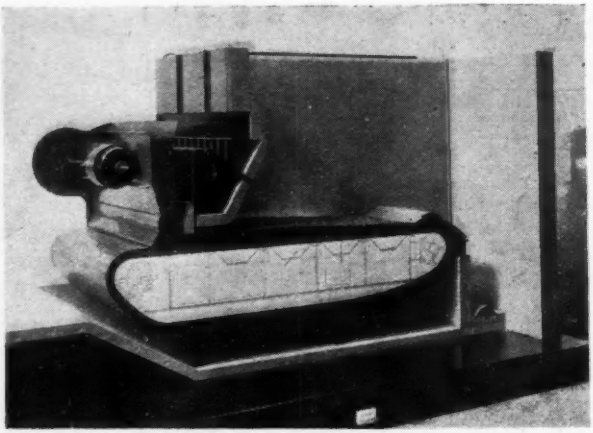
The modern travelling grate offers many advantages and will burn practically any type of coal offered, provided that the designer of the stoker is aware beforehand of the lowest grade of fuel likely to be used. The travelling grate furnace carries large quantities of fuel and consequently has considerable heat reserve. For installations which have to deal with frequent and sud-



Interior view of partly-constructed water-tube boiler for pulverised fuel-firing. Note the large combustion space provided.

(Below) Louvre stoker assembly on site, showing fire-bars being fitted to driving chain.





**A model showing operation of the Louvre stoker.**

den load changes, however, the spreader stoker has many advantages.

The spreader stoker consists of a rotor mounted on the front plate of the stoker above the fire-bed. The fuel is fed to the blade of the rotor and is thrown evenly over the whole grate areas. The heavier pieces of coal fall to the bed to burn and the fines are burnt in suspension. A grit catcher is part of the spreader stoker equipment, the grits being refired at the rear of the combustion chamber. As the depth of the fire-bed is four to six inches the furnace is sufficiently flexible to meet all load changes without appreciable lag. The ash is always at the bottom of the grate in this type of stoker and is kept comparatively cool by the incoming air. By using the slow-moving travelling grate, ash removal can be automatic, the ash being dumped at either the front or back of the furnace as desired. Spreader stokers are built up in sections to the required width and each section is complete with its own feeder.

The output of industrial boilers of the header type can be greatly increased by reconstruction provided that the pressure parts of the boiler are in good condition. The procedure adopted is to raise the drums, headers and tubes, and instal underneath a modern water cooled furnace provided with a new stoker to give increased output. The limiting factor in this type of boiler reconstruction is the circulation system of the boiler concerned, but notable results have been achieved. In an extreme case, boilers installed at a chemical works and designed for an output of 35,000 lb. steam per hour were reconstructed to produce 75,000 lb. per hour, although at the higher figure the limiting factor made performance somewhat erratic. In another instance the boilers in a glass works were modified to increase the evaporation from 30,000 to 50,000 lb./hr. with very satisfactory results. When increased boiler capacity is required and the installation of a completely new plant is not practicable this type of modification can often be carried out with very good results.

## A New Detergent Powder

MANCHESTER Oil Refinery, Ltd., is constructing full-scale plant for the manufacture of a petroleum-derived detergent/wetting agent in the form of a fine powder to be known as Petrosol powder. Intensive research work on the petroleum sulphonates group has led to this development, stimulated by the success of the parallel liquid product, Petrosol 33, which has proved its value in practical applications to a wide range of industrial, commercial and other specialised uses. Composition of the detergent powder will be: 80 per cent sulphonates of hydrocarbons; 20 per cent anhydrous sodium sulphate.

The plant will come into operation within the next few months and it is estimated that production will be equivalent to approximately 7000 tons annually of so-called "conventional" soaps. Quantity production of the powder will be made possible by the installation of spray-drying equipment for handling the large volumes of aqueous solution which form the basis of the product. Petrosol powder will be distributed through Petromor, Ltd. (a member of the M.O.R. group of companies), Jacey House, 16 Oxford Street, Manchester 1.

# Coal Figures

COAL production statistics for February, released by the Ministry of Fuel and Power, show that despite the weather output was higher than in the same month last year, though distributed stocks show a continued decline.

Consumption at the beginning of February was higher than in the same period of 1946, though output had overtaken consumption by February 15, when it totalled 3,777,100 tons, with consumption at 3,729,000. After the restoration of power to industry, however, consumption again outran output; and by March 8 the figures were 3,622,000 tons produced, 3,753,400 tons consumed.

Output of deep-mined coal in the week to February 1 was 3,625,900 tons (compared with 3,425,900 tons in the corresponding week of 1946); in the week to March 15 it was 3,649,300 (3,609,300). The total weekly output in February averaged 3,628,800 tons.

Total distributed stocks on March 8 were 5,342,100 tons (compared with 7,511,800 on March 9, 1946).

Labour recruitment figures show an improvement, the total figure for February being 7750 (compared with 7500 in January and 6350 in February, 1946). Juvenile entrants totalled 1780 (880 in February, 1946); ex-miners from the Forces, 690 (3360); ex-miners from other industries, 2590 (1400); other than ex-miners from other industries, 1190 (340).

Consumption figures show that whereas there was saving by industrial consumers in February, as compared with the same month last year, domestic consumption was higher by comparison with last year. Thus, the average weekly consumption by industrial consumers was 772,000 tons in February this year as compared with 896,000 tons in 1946, while that of domestic consumers was 821,000 tons, as compared with 782,000 tons.

# 44-Hour Week

PLANS for the general adoption of a 44-hour week for chemical workers, representing in many cases the reduction of the working week to five days, were finally ratified by employers in conference with the union representatives last week. As a result of discussions by the Joint Industrial Council for the chemical industry, acceptance was recently given by the Association of Chemical and Allied Employers to the principle of the 44-hour week. The new agreement will take effect on the first pay day in June, when rates of pay and day and shift workers will be adjusted so as to provide approximately the same pay for the shorter week. Some very slight discrepancies may occur.

A 44-hour, five-day week has lately been adopted for all workers in the light castings industry. This followed negotiations between the Light Castings Iron Foundries Federation and the Joint Comittee of the Light Metal Trades Unions, and a condition imposed by the employers was that the agreement should be subject to no reduction of output ensuing. Rates of pay remain unchanged for the shorter week and certain classes of piece-workers now receive 3s. more per week as national bonus money.

An agreement being discussed by the Iron and Steel and Kindred Trades Association and representatives of employers proposes to extend the working week by the inclusion of week-end work, principally in smelting shops, in a number of Scottish steel works. The proposals are that 21 shifts shall be worked each week, instead of 18, and workers shall get time off during the week. It is hoped to operate the new system as from the beginning of April without increasing the labour force.

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Woodwork set alight by a heater caused a fire in the chemical works of Cross & Co., Ltd., Radcliffe.

# Quest for Power Units

ONE of the very few beneficial results of the fuel emergency, a greatly increased sale of electric generating sets from manufacturers and surplus Government stores, is recorded by the Board of Trade. More than 3500 generators and 300 alternators were disposed of by the Government in February and many applications are still being dealt with. Although the main demand has been for large capacity and diesel-powered A.C. 3-phase 50-cycle sets, much ingenuity has been shown in adapting the smaller capacity sets of which the surplus stocks largely consist. Selling agencies have been established at three provincial centres, Hinton in the Hedges (Banbury), Ashchurch (Glos.), and Taunton, where stocks are being very rapidly disposed of. Applications are also being dealt with by the Directorate of Disposals, Ministry of Supply, Horseferry Road, London, S.W.1, and there are limited facilities for loaning sets administered by Regional Controllers.

The same influences have facilitated the recent sale to the gas industry of several gas-producer plants, installed to meet wartime emergencies. One blue water-gas plant with an output of 8 million cu. ft. per day, is in course of being sold to augment the nation's output of gas next winter.

Gas-producers, having outputs from 15,000 cu. ft. per hour to 150,000 cu. ft. per hour, are still available, and particulars can be obtained from the Ministry of Supply.

# Fireproofing of Fabrics

## Good Results with Insoluble Chemicals

A FURTHER important extension of the field in which chemicals may in future serve the textile industry is foreshadowed in the publication of a review by Dr. J. E. Ramsbottom, D.Sc., Ph.D., F.R.Ae.S., of work which has been going on for several years at the Chemical Department of the Royal Aircraft Establishment, South Farnborough, to discover the best chemical means of rendering textiles less susceptible to fire risks. The part which curtains and other fabrics play in any domestic conflagration is notorious and makes the extremely painstaking research which has been carried on at South Farnborough worth the effort, in view of the positive results which have been obtained. A wide range of chemicals has been used with varying success and in some cases with eminently successful results. The object, it should be explained, was not to render textiles "fireproof" in the dictionary sense of the term but to evolve "a treatment with suitable deposits which increases the resistance of a fabric to fire so that it becomes incapable of propagating flame." Dr. Ramsbottom's *The Fireproofing of Fabrics* (Department of Scientific and Industrial Research; H.M. Stationery Office, 2s. 6d.) shows that the number of chemicals capable of producing this result is far larger than was thought, but the choice has been narrowed by the fact that a fairly large proportion of these have destructive propensities or are liable to alter the characteristics of the fabrics. A dozen other considerations have been taken into account, so that the list of suitable chemicals has been reduced to manageable proportions.

### Water Soluble Deposits

Fireproofing with water soluble deposits is cheap and easy; it is popular and, where the proofed material is not subsequently exposed to the action of water, some quite simple and readily obtainable inorganic salts deposited in relatively small amounts on the fabric are shown to be effective in preventing flame and glow (smouldering) without detrimental effects on strength and handle. The salts chosen are not toxic and do not accelerate corrosion of metals with which the fabric may be in contact. Tests were made on many substances and mixtures and a review of the most effective of these shows that mixtures are better than single substances and that borax is an important constituent of them all. Examples are given of six proofings effective at small concentrations. The final choice is a mixture of boric acid and sodium phosphate, and a suitable composition and strength of solution is given.

The second branch of the investigation, in insoluble inorganic deposits necessitated research with a great number of substances. These deposits were generally formed on the fabric by double decomposition, the fabric being impregnated with a solution of one of the reactants and dried and then passed through a solution of the precipitating substance. In a few cases impregnation in single solutions followed by drying and then immersion in boiling water led to the formation of an insoluble deposit on the fabric. Many insoluble deposits hitherto claimed to be fireproofers were shown to be ineffective.

| A | | B | |
|---|---|---|---|
| Ammonium borate ... | 24 | Ammonium vanadate | 9 |
| Ammonium bromide | 7 | Arsenic acid ... ... | 20 |
| Ammonium chloride | 22 | Lithium hydroxide ... | 5 |
| Ammonium iodide ... | 14 | Potassium carbonate | 16 |
| Ammonium molybdate ... ... | 7 | Potassium hydroxide | 8 |
| Ammonium phosphate ... ... | 12 | Potassium nitrate ... | 13 |
| Ammonium sulphate | 18 | Potassium permanganate ... ... | 22 |
| Borax ... ... | 60 | Potassium phosphate | 27 |
| Calcium chloride ... | 14 | Potassium di-hydrogen phosphate ... | 30 |
| Magnesium chloride | 16 | Potassium thiocyanate ... ... ... | 25 |
| Phosphoric acid ... | 12 | Sodium bicarbonate | 23 |
| Sodium aluminate ... | 19 | Sodium carbonate ... | 12 |
| Sodium arsenate ... | 33 | Sodium hydroxide ... | 10 |
| Sodium bisulphate ... | 30 | Sodium molybdate ... | 6 |
| Sodium silicate ... | 20 | Sodium phosphate ... | 20 |
| Sodium stannate ... | 18 | Sodium selenite ... | 36 |
| Sodium tungstate ... | 9 | Sodium vanadate ... | 2½ |
| Zinc chloride ... | 12 | | |

Two successful methods described consisted in the deposition in balanced amounts of the oxides of iron, tin and tungsten in one method and these same oxides with the addition of silica in the second method. A successful ternary deposit of ferric oxide, stannic oxide and chlorpolyvinyl chloride is mentioned.

In addition to studying domestic and commercial fabrics, the scientific team has closely examined the equally urgent problems of proofing aircraft fabric and kapok, both of which present exceptional fire risks and special problems because of their peculiar characteristics. Two successful methods of proofing kapok were, in one, the application of an insoluble deposit of stannic oxide, tungstic oxide and alumina followed by after-treatment with boric acid; the other employed a simple deposit of alumina after-treated with boric acid.

No satisfactory fireproofing treatment was found for aircraft fabric coated with nitro or acetyl cellulose dope, but with dopes made from chlorpolyvinyl chloride previous treatment of the fabric with 20 per cent by

weight of ferric or stannic oxide gave a permanently fireproof effect.

The relative effectiveness of a wide range of chemicals in retarding or preventing combustion without causing other undesirable effects is presented in a number of tables of which the one reproduced represents proofing values of simple soluble deposits. Column A represents fireproofers and glowproofers, Column B fireproofers only. The figures accompanying the substances are the minimum quantities required to prevent flame propagation and therefore represent their relative effectiveness.

The ineffectiveness of most of the much more desirable insoluble substances when compared with the soluble chemicals is outstanding. In the insoluble group antimony oxychloride alone is listed, with the quantity figure 30, as effective against flame and glow. The ten following are given as effective fireproofers only, and there is a long list of ineffectives:

Aluminium stannate, 54; antimonious oxide, 79; ferric chromate, 24; ferric oxide, 19; lead chromate, 37; lead monoxide, 21; manganese dioxide, 22; stannic oxide, 20; tin tungstate, 50; zinc stannate, 40.

The bulk of the evidence is that the treatment most likely to be finally adopted will be an elaboration of one of the insoluble ternary or quaternary mixtures.

## Chemists Honoured

### New Fellows of Royal Society

SEVERAL well-known chemists are among the new Fellows of the Royal Society who were elected at a meeting of the Royal Society on Thursday last week.

Mrs. Dorothy Hodgkin

The full list of the new Fellows is as follows:

BENNETT, G. M. Government chemist. Distinguished for his work in organic chemistry on the reactivity and configuration of organic molecules.

CONWAY, E. J. Professor of Biochemistry, University College, Dublin. Distinguished for his work on chemical and physicochemical processes in living tissues.

EVANS, M. G. Professor of Physical Chemistry and head of the Department of Chemistry, Leeds. Distinguished for his contribution to chemical kinetics and especially for his theoretical work on the modern concepts of reaction velocities.

HODGKIN, DOROTHY CROWFOOT. Fellow and Tutor of Somerville College, Oxford, and University demonstrator in chemical crystallograph. Distinguished for a long series of investigations by X-ray crystal analysis into the structure of the sterols, proteins and other complex organic molecules.

KREBS, H. A. Professor of Biochemistry, Sheffield. Distinguished for his work on intermediary reactions in cell metabolism.

MANN, F. G. Reader in Organic Chemistry and Fellow of Trinity College, Cambridge. Distinguished for his work on stereochemistry with particular reference to complex metallic salts and derivatives of arsenic phosphorus and antimony.

Dr. G. M. Bennett

PANETH, FRITZ. Professor of Chemistry, University of Durham. Distinguished for his pioneering researches in radio-chemistry and for the discovery of free organic radicles of short life. He has undertaken chemical and radiochemical work in connection with atomic energy.

## Oil Prices Increased

INCREASES are announced by the Ministry of Food in the prices of a number of unrefined oils and fats and technical animal fats allocated to primary wholesalers and large trade users. The purpose of these changes, which are operative as from March 30, 1947, is to bring prices into conformity with costs, it is explained. Products affected include the following, all prices being per ton.

COCONUT OIL, price increased by £26 to £106 naked ex works.

PALM KERNEL OIL, increased by £26 10s. to £105 10s. naked ex works.

COTTONSEED OIL (crude), increased by £29 to £109 naked ex works; (washed), increased by £28 to £112 naked ex works.

GROUNDNUT OIL, increased by £28 10s. to £110 10s. naked ex works.

PALM OIL, increased by £40 15s. to £99 5s. (c.i.f. in returnable casks); £98 15s. c.i.f. in loan drums); £97 15s. (c.i.f. in bulk).

WHALE OIL (Crude No. 1), increased by £27 10s. to £103 10s. naked ex store; (Crude No. 2), £27 10s. to £102 naked ex store; (Crude No. 3), £27 10s. to £99 naked ex store; (Crude No. 4), £27 10s. to £91 naked ex store; (Crude hardened 42°), £25 to £109 naked ex works; (Crude hardened to 46/48°), £25 to £110 naked ex works; (Crude hardened to 50/52°), £25 to £111 naked ex works; (Crude hardened to 54s.), £25 to £111 10s. naked ex works; (Iodine Value 3/5), £25 to £111 10s. naked ex works.

ACID OILS: Coconut and/or Palm Kernel, increased by £39 to £97 10s. naked ex works; Groundnut, £39 to £94 naked ex works; Soya, £39 to £92 naked ex works.

## Price of Aluminium Rises

ALUminium Price Increase

The Minister of Supply announces that as from March 24, 1947, the price of virgin aluminium in ingot or notch bar form will be increased from £72 15s. to £80 per long ton delivered into consumers' works. The new price will apply to metal of a purity of 99 per cent to 99.5 per cent inclusive, with premiums as follows for higher purities:

| *Purity* | *Price per ton* £ |
|---|---|
| Minimum 99.6% | 88 |
| Minimum 99.7% | 92 |
| Minimum 99.8% | 97 |
| Minimum 99.9% | 130 |
| Minimum 99.99% | 180 |

**Soda and Ink in Ceylon.**—The manufacture of soda and ink is to be developed in Ceylon, where two experts are to be appointed in these fields.

## U.S. Chemical Profits

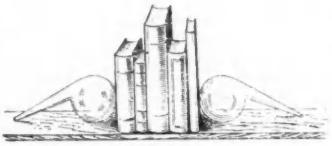
THE healthy condition of some branches of American chemical industry is reflected in the recently published trading accounts of several large-scale undertakings, of which those of the Victor Chemical Works and the Monsanto Chemical Company are not isolated cases. The Victor Chemical undertaking has shown a net profit for 1946 of $2,114,658, comparing with $1,128,263 in 1945, permitting a distribution of $2.65 per common share against $1.51 the previous year. The Monsanto Chemical Company in 1946 secured net earnings higher than ever before in its 46 years' activity: $10,084,149 after payment of all taxes and charges, representing an increase of 90 per cent upon the 1945 net profit of $5,318,003. The company's net sales, exclusive of the British and Australian subsidiaries, $99,590,790, are 4 per cent more than the previous year's.

In an optimistic annual report, E.I. Du Pont de Nemours & Co., disclosed that 1946 operations had set a new production record, "in line with the high degree of industrial activity" enjoyed by the chemical industry throughout the United States. Du Pont production, the report stated, in 1946 was substantially larger than that of any previous peace-time year and more than double 1939 totals. Sales for 1946 totalled $648,700,000, highest in the company's 145-year history and 6 per cent over those of the previous year. Dividends paid in 1946 totalled $7.00 a share on common stock. Operating income for the year was reported as $83,962,000 after payment of taxes. The year saw almost complete termination of the company's war production responsibilities.

The annual report of the Celanese Corporation of America, manufacturers of chemicals, textiles and plastics, reveals that 1946 sales were at an all time peak of $135,202,211 and net income was $16,059,416, equivalent to $2.36 a common share. In the field of research activities the company spent $2,284,571 in 1946. The two research fields in which the company specialises—cellulose chemistry and petroleum chemistry—"offer broad opportunities for future achievement," the report claimed.

## Soft Drinks Order

The Minister of Food has made an Order amending the Soft Drinks Order, 1946, permitting the use of tartaric acid and phosphoric acid in certain soft drinks and clarifying the definition of a soft drink and the term "total acid content" in the provisions as to ingredients. Tartaric acid may now be used in the manufacture of soft drinks other than those containing citrus fruit juice and phosphoric acid may be used in those drinks which do not contain any fruit juice.



# A CHEMIST'S BOOKSHELF

**Calcium Superphosphate and Compound Fertilisers: Their Chemistry and Manufacture.** By P. Parrish and A. Ogilvie. 2nd Edition. Hutchinson's Scientific and Technical Publications. 279 pp. 50s. net.

Those who have used the 1st edition of this well-known book will need no urging to obtain the 2nd edition. The authors can be relied upon to present an authoritative treatise on their subject and this they have done. The manufacture of mineral fertilisers promises to be of major importance to this country. The ravages of war that have reduced agricultural production all over Europe—and in other countries—have come at a time when there has been a great increase in the purchasing power of the lower-income groups. The great mass of our people now live better than they have ever done before and will eat far more food than ever before—when it becomes available. Yet recently, the agricultural correspondent of *The Times* reported: "Unhappily imports of potash have not kept pace with requirements in recent months, and some farmers, although they have the permits to buy potash fertilisers, will have to sow their crops without this essential plant food. . . . It is unhappily a fact that the manufacture of other fertilisers, such as sulphate of ammonia and superphosphate, has been checked." The growing demand for fertilisers makes this one of the key industries of the world.

Since the first edition of this book was published in 1939 the major advance in the industry has been the development of new methods of granulating calcium superphosphate and N.P.K. fertilisers. These methods are fully described in chapter XVII of the book. It might have been useful if the authors instead of contenting themselves with describing the new methods had indicated also the principles underlying them. No one will doubt that granulated products are more effective, but it is interesting to observe that there is still no agreement as to the most suitable size of granule. The true granulated product 1¼-4 mm. would appear to be the best scientifically but the war-time product 4 mm.-dust, with 15-20 per cent below 1½ mm. has proved so good in practice that it may well continue to be used.

The other principal change in the book is a complete re-writing of the first chapter which now gives a detailed account of the ramifications of the fertiliser industry and indicates the changes which are likely to occur in the next few years. The authors here suggest that the water-solubility test is out-moded and is hampering the development of the industry. Mr. Parrish is apt to be in advance of his colleagues in many respects and it is clear that his suggestion will not be generally accepted as yet. Mr. Walter Packard in a foreword expresses himself as being averse from this change for, he says, "I remember the harm done to the basic slag trade, and the confusion caused in the mind of the farmer, when the citric solubility test, which, although only a relative test, was at least some criterion as to the value of a slag to plant life, was dispensed with. It is to be hoped that water solubility as a test of the value of superphosphate will never be departed from in this country until it is proved that water-soluble phosphate is not the quickest acting form of phosphate plant food." On the other hand the authors both in their first edition and in this present edition have brought forward weighty evidence in support of the view that even better results may be obtained from a citrate-soluble, water-insoluble phosphate than from ordinary superphosphate.

The future of the superphosphate industry is a matter of considerable interest. It is not, and probably never will be, as large an industry as the ammonia and for that reason, since this is the day of the big company, it may well be that some linkage of manufacture is desirable in order to increase stability and to reduce manufacturing costs. The authors have thrown in a pretty bone of contention by their statement that "It is felt that the calcium superphosphate industry in this country should have linked itself with the gas industry long ago, as the latter has been in a position to provide sulphur in the form of spent oxide and by-product ammonia, and mutual advantage would have resulted from a consolidation of interests."

This book is in no need of any recommendations. It is the standard textbook on the industry, and nothing more need be said by way of appraisement.

J. E. FOXWELL.

## German Technical Reports

FOLLOWING are among the latest technical reports from the Intelligence Committee in Germany, copies obtainable from H.M. Stationery Office at the prices quoted.

*CIOS XXXI–47. Deutsche Edelstahlwerke A.G.*, Krefeld (Research Laboratory): Properties of steels. Alloy economy, etc. (1s. 6d.).

*BIOS* 561. *I.G. Farben Fabrik*, Wolfen. Manufacture of sodium sulphide (1s. 6d.).

*BIOS* 706. Metal powders (sintered) (13s.).

*BIOS* 788 (Appendix). German vitreous enamel industry (1s. 6d.)

*BIOS* 833. Investigation of German commercial explosives industry (8s.).

*BIOS* 880. *I.G. Ludwigshafen*: Interrogataion of Herr Johannsen: Sodium hydrosulphite, rongalit, and liquid sulphur dioxide manufacture (1s. 6d.).

*BIOS* 883. Notes on casting and fabrication of lead and production of Bahnmetall (2s. 6d.).

*BIOS* 887. *Henkel and Cie, Dusseldorf*: Spray drying, fatty acid distillation, sodium perborate (2s. 6d.).

*BIOS* 960. German dyestuffs and dyestuffs intermediates. Anthrasols, heliogens, sirius light blue dyestuffs (8s.).

*BIOS* 976. *Lurgi-Thermic G.m.b.H.*, Horrem: Electro-thermic production of aluminium-silicon alloys (1s.).

*BIOS* 978. Manufacture of formaldehyde. Interrogation of Drs. Johannes Casper and Rudolph Stroh (*I.G. Leverkusen*) and Dr. Ernst Baerwind, Degussa (1s. 6d.).

*BIOS* 995. Hot-dipping and electro-deposition of tin and tin alloys in Germany (4s.).

*BIOS* 1001. Bitterfeld: Manufacture of chlorinated polyvinyl chloride (4s. 6d.).

*BIOS* 1003. Some aspects of copper, nickel and cobalt production in Germany (3s.).

*BIOS* 1087. Manufacture of chemical stoneware in Germany (4s.).

*BIOS* 1090. *I.G. Farbenindustrie*, Dormagen: Cellulose acetate manufacture. Interrogation of Drs. Rohm, Schnegg and Ziegler (1s.).

*FIAT* 792. Iron cores. Manufacture of low hysteresis iron and iron-nickel powder cores (1s. 6d.).

*FIAT* 808. Contribution to the regeneration of pickling solutions (1s.).

*FIAT* 869. New method of beneficiation of low-grade iron ore by the Wiedelmann washing tower (1s.).

*FIAT* 917. *I.G. Farbenindustrie* plant in Ludwigshafen: Manufacture of 2-ethyl anthraquinone (1s. 6d.).

*FIAT* 925. *I.G. Farbenindustrie* plant at Oppau: Formamide production (1s.).

*BIOS* 847. German chlorine plants in the American, French and British zones. Part II: Liquid chlorine, including distribution of gaseous chlorine (2s. 6d.).

*BIOS* 848. German chlorine plants in the American, French and British zones. Part III: Synthetic hydrochloric acid (3s. 6d.).

*BIOS* 849. German chlorine plants in the American, French and British zones. Part IV: Sodium hypochlorite (1s. 6d.).

*BIOS* 850. German chlorine plants in the American, French and British zones. Part V: Evaporation and finishing of diaphragm gell caustic soda liquor (2s. 6d.).

*BIOS* 981. Light alloys. Notes on German technique on continuous casting and extrusion of aluminium alloys with particular reference to tube extrusion. Tube reducing machines and vertical extrusion presses (2s.).

## The Chemical Society

### Anniversary Meeting

THIS year the anniversary meeting of the Chemical Society—the 106th—was of special interest in that 1947 will see the delayed celebration of the Society's centenary.

The annual general meeting took place on Thursday morning of last week at the Society's rooms in Burlington House, followed by the anniversary luncheon at the Dorchester Hotel, when the chief guest was Viscount Bennett, P.C., K.C., LL.D., a former Prime Minister of Canada and president of the Royal Society of Arts, and the presidential address was by Professor C. N. Hinshelwood, M.A., Sc.D., F.R.S. In the evening, as relaxation after a day devoted largely to matters of administrative and scientific importance, there was a visit to the New Theatre for the Old Vic Company's production of Ben Johnson's "The Alchemist."

At the luncheon, the toast of "The Chemical Society" was proposed by Viscount Bennett, and the president replied. Other guests present included Dr. G. Roche Lynch, president of the Royal Institute of Chemistry, Dr. L. H. Lampitt, president of the Society of Chemical Industry, Professor E. K. Rideal, chairman of the Chemical Council, and Sir Edward Salisbury, Director of the Royal Botanic Gardens, Kew, and a secretary of the Royal Society. The president took as the subject of his address "Some observations on present-day chemical kinetics."

Considerable progress in many fields of activity was shown in the council's annual report for 1946. Evidence of the scope and extent of the Society's work is that the cost of producing its various publications now exceeds £12,000, while fellowship of the Society is nearly seven thousand strong.

# American Chemical Notebook

*From Our New York Correspondent*

A NEW sulphur flotation plant to treat 300,000 metric tons of accumulated residue is being constructed by the *Compañia Azufrera Aucanquilcha* at Ollague, Chile. The plant is designed to handle 100 tons daily of residue containing 40 per cent of sulphur and to recover 18-20 tons of fine sulphur. Working conditions are difficult, as the mine is in the Cordillera at a height of 18,000 ft., while the plant is at 13,000 ft. The plant is expected to be in operation in April.

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Production of liquid chlorine is now proceeding in Paramonga, Peru, and is expected to total approximately 800 metric tons yearly, thus allowing for substantial exports since local requirements do not exceed 100 tons.

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An increased but still far from normal supply of tung oil may be expected this year, according to a speaker at the annual convention of the National Paint, Varnish and Lacquer Association. Imports into the States would be much below normal, he said, while the decline in China's tung oil output was estimated at from 25 to 50 per cent. He noted that in 1946 the United States was allocated some 60 per cent of 25,000 tons expected from China, the United Kingdom and Russia receiving most of the balance. In addition, the International Emergency Food Council allocated 2000 tons of Argentine tung oil—85 per cent to Europe and 15 per cent to the States. In forecasting an increased supply in 1947, the speaker said United States home production of tung oil was estimated to be up to 15,000,000 lb. and that Argentine and Chinese exports were expected to increase.

* * *

The study of liquids as they approach freezing point is the subject of research planned between the Stevens Institute of Technology and the U.S. Office of Naval Research. Dr. John B. Hawkes, who was active in war-time research, will be in charge. The changes which take place in liquids as they approach freezing point, are related to the changes which occur in cast metal as it solidifies; more detailed knowledge of what occurs when liquid freezes should lead to better understanding of the problems of casting metals and plastics.

* * *

The possibility of using certain types of bacteria to increase the recovery of oil from subterranean deposits is suggested by a patent recently issued to Dr. C. E. ZoBell, of the University of California's Scripps Institute of Oceanography. While testing various kinds of bacteria for their ability to modify crude oils, Dr. ZoBell observed that certain cultures released droplets of oil from test tubes filled with calcareous material prepared to simulate underground oil-producing formations. Subsequent experiments showed that bacteria can release oil from oil-bearing sediments by (i) dissolving calcareous materials; (ii) crowding off the oil physically; (iii) producing surface-active substances—literally, "bacteria soap." The patent has been assigned to the American Petroleum Institute for free public use everywhere. Practical applications of the oil-releasing bacteria are now being carried out by the Pennsylvania Grade Crude Oil Association.

* * *

A spray mixture claimed to eliminate hand labour in the thinning of many types of fruit trees has been produced by B. F. Goodrich Chemical Co. It is a mixture of Goodrite p.e.p.s. (polyethylene, polysulphide, and zinc dimethyl dithiocarbamate and cyclo-hexylamine). Tests conducted by the Delaware Agricultural Experimental Station, it is reported, have shown that the number of fruits per apple tree can be reduced up to 50 per cent by use of the new mixture two weeks after full bloom. It is also claimed that it contains fungicidal properties and prevents other chemicals from being washed away by rain or other elements.

* * *

Technetium, astatine, and francium are the names given by their discoverers to elements 43, 85 and 87 respectively. Technetium (symbol Tc) was the first artificially-made element, formed by neutron or deutron bombardment of molybdenum in 1937 in the 37-inch cyclotron at the University of California by Drs. C. Perrier and E. Segre; considerable amounts of technetium have been isolated as a by-product of atomic bomb research. Astatine (At) was also first made in a cyclotron by bombarding bismuth with alpha particles; it was the co-discovery of Drs. Segre, D. R. Corson and K. R. Mackenzie. The French discoverer of francium (Fr), Mlle. M. Perey, has named element 87 after her native country, as Mme. Curie named polonium after her native Poland. The only element awaiting a name is element 61, discovered in the fission products of the atomic pile by a group of scientists, led by Professor C. D. Coryell.

# Glasses for the Laboratory—I

by I. C. P. SMITH, B.Sc., F.R.I.C.

THE obvious preliminary to a series of articles on scientific glass-blowing, both as an industry and as an essential to the practice of chemistry, the types of glass which are usually met with in the laboratory and in the glass-blowing works must first be reviewed, so that the reader may become familiar not only with their outstanding properties, but also with some of the trade terms, the understanding of which greatly simplifies descriptions. Generally such glasses come under the three headings of (1) soda or soft soda; (2) lead; and (3) resistance or hard glasses. There are in addition a few more used for special purposes, and of course the optical glasses, but the latter do not come within the scope of this article.

## "Crown" Glass

Soft soda glass is derived from the ordinary soda-lime-silica glass, otherwise called "crown" glass, which has been used for centuries for making window-panes, bottles and cheap table-ware. The main constituents are silica ($SiO_2$) 65-70 per cent, sodium oxide ($Na_2O$) 14-20 per cent, lime (CaO) 6-13 per cent. The soda may be replaced in whole or in part by potassium oxide and part of the lime by magnesia, MgO. It will be simpler to refer to the sodium oxide in the remainder of the article as "soda" and potassium oxide as "potash."

Glasses made from these constituents have good resistance to weathering, and would be suitable for the manufacture of articles straight from the furnace, for example, machine-made bottles, pressed dishes, or rolled plate. If, however, the glass were worked in the blow-pipe flame it would be found to devitrify very rapidly. The main difference in working conditions is that in performing machine operations the glass is cooled rapidly through the region where crystallisation might occur. In the blow-pipe flame, however, not only may the glass be held at a temperature suitable for crystallisation but also soda may be volatilised from the surface, aggravating this effect. In order to overcome these defects further oxides are introduced, generally replacing some of the lime; the most effective of these is alumina ($Al_2O_3$) used in quantities up to 4 per cent. Besides conferring on the glass good working properties in the blow-lamp, this substitution increases the mechanical strength. Boric oxide ($B_2O_3$) is also introduced in small percentages, usually replacing some of the soda; it has a low melting point and so has value as a flux, but at the same time it confers, unlike the soda, a low coefficient of expansion. Magnesia mixed with the lime also tends to check devitrification, but does not confer the necessary flame-working properties.

Using only the oxides mentioned, one can make a number of glasses suitable for lamp-working. As shown in Table I, these differ in detail composition so as to make a compromise between one property and another, or to impart certain desirable characteristics; among these are ease of melting or fining when the glass is made in the pot or tank (fining is clarifying the melt from the tiny bubbles of occluded air or reaction gases); a long working range in the flame; ease of annealing; matching the expansion to that of a metal sealing wire, etc.

TABLE 1.

| | | | Wembley | | | | (1) Crown | (2) Fourcault | (3) | (4) | (5) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Dial | X7 | X4 | X8 | Traditional | Window | Container | Egyptian 1500 BC | Roman 100 AD |
| Silica | $SiO_2$ | ... | 67.7 | 68.1 | 72.1 | 69.2 | 71.5 | 72.0 | 74.0 | 67.0 | 64.1 |
| Sodium Oxide | $Na_2O$ | ... | 19.5 | 18.4 | — | 16.0 | 14.0 | 16.0 | 17.0 | 10.1 | 18.3 |
| Potassium Oxide | $K_2O$ | ... | 0.3 | 2.3 | 20.6 | 0.9 | — | — | — | 1.8 | 0.8 |
| Lime | CaO | ... | 6.1 | 5.6 | 3.0 | 5.8 | 13.0 | 8.0 | 5.0 | 7.8 | 6.1 |
| Magnesia | MgO | ... | 0.6 | 1.1 | 3.9 | 3.6 | — | 3.0 | 3.5 | 4.9 | 1.3 |
| Boric Oxide | $B_2O_3$ | ... | 1.8 | 0.7 | — | 1.2 | — | — | — | — | — |
| Alumina | $Al_2O_3$ | ... | 4.0 | 3.9 | — | 3.5 | 1.5 | 1.6 | 0.5 | 2.5 | 3.6 |
| Co-eff. of Expansion | No.-6 | ... | 10.1 | 10.1 | 9.55 | 9.7 | — | — | — | $Mn_2O_3$, $Fe_2O_3$, Cu O } 5.3 | } 3.2 |

## Laboratory Types

The most popular soda glasses for general laboratory purposes before the war were, Dial soda and Wembley X7; the latter was made in bulk by a machine-drawing process, and was particularly adapted to the neon lighting industry. The Dial soda was made in pots and the tubing drawn by hand, as were also the heavy wall tubing and capillary sizes in X7. Both these glasses had excellent flame-working characteristics and could be repeatedly melted without devitrifying. They could also be joined to one another.

The Wembley X4 was a glass made specially for electric light bulbs, including the large quantities of carefully gauged tubing

and rod required to form the internal parts of the bulb. The glass was made in a tank and the tubing machine drawn. Besides being suitable for machine working, that is, making up the parts of the bulb on automatic machines, the glass was designed to carry, sometimes in conjunction with an intermediate sealing glass, the wires leading to and supporting the filament. With the outbreak of hostilities there came a shortage of potash on the one hand, and a call to co-ordinate output on the other, leading to the compromise glass X8, which replaced X4 and X7. The new glass, which is used throughout the country now, has not quite the flame-working properties of X7, but serves admirably for most purposes. It is employed in conjunction with the similar B.T.H. glass C22 by both laboratories and manufacturers for the multifarious pieces of small glassware which are used by the chemist, the pharmacist, and the medical man.

## Qualities Compared

Table 1 also includes the following glasses for comparison: (1) The "crown" glass which has been handed down through the ages, and is found in the laboratory as hand-made bottles, aspirators, vacuum-desiccators, Drechsel bottles, graduated flasks and cylinders, etc.

(2) A composition suitable for making window glass by the Fourcault or vertical drawing process.

(3 Suitable for machine-made bottles and pressed ware.

(4) A dark blue glass found in Egypt, and dating about 1500 B.C.

(5) A dark blue, transparent glass made in Rome 50 to 200 A.D.

It will be seen that, except for the colouring oxides, the formulae of the last two are quite "modern."

Lead glass is used very little now for ordinary laboratory purposes, although it was used extensively in the early days of chemistry, probably owing to its ease of working with the simple burners then available. It is employed, however, in the manufacture of many types of thermometers and barometers, and for thermionic valves and cathode-ray tubes; it is also a convenient intermediate glass for sealing wires through soda glass. In America lead glass is usually preferred to soda glass for neon lighting.

Table 2 gives some of the lead glasses at present in use, comparing them with the original flint glass. No. 1 is a glass used for thermometer stems and for barometer tubes; and No. 2 is the opal backing which is incorporated in the stems. No. 3, included in this table for convenience, is the "normal thermometer" glass used for the bulbs only of thermometers; it has good thermometric properties, *i.e.*, the ability to expand and contract in a normal manner, instead of showing that delay in returning to the original size which is a characteristic of most glasses. The high alumina and zinc oxide may be noted, also the low potash figure compared with the soda.

No. 4 in Table II is a glass specially designed as an intermediate layer for sealing platinum or nickel-iron alloy wires, as in electric lamp and radio-valve manufacture. In this it has better electrical insulating properties than a soda-lime glass.

No. 5 is a typical lead crystal or flint glass used for high quality table-ware.

TABLE 2.

| | | (1) Thermometer Stem | (2) Opal | (3) Bulb | (4) Wembley L1 | (5) Lead Crystal |
|---|---|---|---|---|---|---|
| Silica | $SiO_2$ | 60.7 | 57.4 | 65.0 | 55.9 | 54.0 |
| Sodium Oxide | $Na_2O$ | 10.2 | 10.4 | 13.8 | 5.0 | 10.0 |
| Potassium Oxide | $K_2O$ | 1.0 | 0.2 | 0.8 | 7.8 | |
| Lead Oxide | PbO | 22.8 | 22.0 | — | 30.2 | 36 |
| Boric Oxide | $B_2O_3$ | 1.3 | — | 2.7 | 0.2 | |
| Alumina | $Al_2O_3$ | 3.0 | — | 5.6 | 0.8 | |
| Lime | CaO | — | 1.12 | 6.8 | — | |
| Arsenic Oxide | $As_2O_3$ | — | 3.82 | — | — | |
| Phosphonic Oxide | $P_2O_5$ | — | 1.9 | — | — | |
| Zinc Oxide | ZnO | — | — | 5.6 | — | |
| Co-eff. of Expansion | No.-6 | — | — | — | 9.1 | |

## High Resistance

Turning now to the glasses designed specially to resist chemical attack or heat shock, we find that the nearer one approches to pure silica the closer does one come to the ideal in a glass for the construction of beakers and flasks. Unfortunately, silica is difficult and expensive to work, particularly the transparent articles which the chemist prefers, so that the compositions represent the most effective compromise between chemical and heat-shock resistance on the one side, and workability on the other. The term "heat-shock resistance" employed as it is more descriptive of the requirements of the glass than heat-resistance.

Table 3 gives a progressive series of the "hard" or "resistance" glasses, starting with that known as "neutral" and employed for ampoules and lymph tubes, when their contents might be affected by soda or other material extracted from the glass. This glass is more chemical- than

heat-resisting and is workable in the ordinary gas-air flame. No. 2 is the old Kavalier glass, one of the earliest compositions to be popular for chemical purposes, although it was probably developed for oil-lamp and incandescent gas chimneys. It is seen to be a simple potash-lime-silica glass, high in silica at the expense of the other constituents. No. 3, the Jena Geräte, owes its development also as much to lamp chimneys as to the requirements of the chemist; it has provided the latter however with a glass of excellent chemical and heat-shock resisting properties. Monax and Wood's

TABLE 3.

| | | (1) Neutral Ampoule | (2) Kavalier | (3) Jena Geräte | (4) Monax | (5) Pyrex | (6) Moncrieff Combustion | (7) Mercury Vapour |
|---|---|---|---|---|---|---|---|---|
| Silica | $SiO_2$ ... ... | 66.4 | 78.3 | 75.3 | 75.3 | 80.5 | 70.5 | 54 |
| Soda | $Na_2O$ ... ... | 10.2 | 1.4 | 5.7 | 6.3 | 3.8 | 2.6 | — |
| Potash | $K_2O$ ... ... | 0.2 | 13.3 | 0.8 | 1.2 | 0.6 | 2.8 | — |
| Lime | CaO ... ... | 6.9 | 6.8 | 1.1 | 0.5 | 0.2 | 7.1 | 13 |
| Magnesia | MgO ... ... | 0.6 | — | — | — | 0.3 | — | — |
| Barytes | BaO ... ... | — | — | 3.5 | — | — | 6.4 | 3 |
| Zinc Oxide | ZnO ... ... | — | — | — | 2.8 | — | — | — |
| Boric Oxide | $B_2O_3$ ... ... | 7.0 | — | 7.6 | 11.3 | 11.9 | 4.5 | 8 |
| Alumina | $Al_2O_3$ ... ... | 8.6 | — | 1.6 | 3.0 | 2.5 | 6.0 | 21.5 |
| Co-eff. of Expansion | No-6 ... ... | 6.8 | — | 4.4 | 4.4 | 3.2 | — | 3.65 |

No. 7 is that it contains no alkali oxide and is sometimes called an alumino-silicate glass.

To complete the picture, two unusual glasses should be mentioned here; one is the "conductivity" glass employed in glass electrodes. This is a straight soda-lime-silica glass but specially high in soda. It is a difficult glass as it is subject to rapid weathering in damp air and must thus be stored in waxed paper wrappings. A small quantity of the glass is blown to a thin walled bulb on the end of a soda glass tube to form an electrode and is used for *p*H and conductivity measurements. Alternatively, it may be drawn to fine thin-walled capillaries, and attached as a bundle to a tube.

The second unusual glass is one made to resist sodium vapour and contains only soda, alumina, and boric oxide, and no silica. This is even more subject to weathering than the conductivity glass and can only be handled and employed as the inner component of a two-layer tube. It is used for sodium vapour discharge lamps.

It will be seen in the tables that coefficients of expansion have been given where they were available, as it is this property in particular which decides whether two glasses will join. If there is a difference in annealing or setting temperature the softer glass will accommodate itself to the harder, but if, once the glasses have set, at the lower annealing temperature, there is a difference in length of contraction with fall of temperature, strains must be set up and no amount of annealing will remove them. Slightly dissimilar glasses in the soda glass range will join only if the wall is thin and the diameter not too great; sometimes a ring of lead glass may be joined between the two soda glasses, as this has a certain flexibility which will accommodate itself to both glasses. In the hard glass range, Monax may be joined to Jena Geräte and Pyrex, Phoenix, and Hysil will join together.

The annealing temperatures of the glasses generally run in series: the lead glasses round about 400°; the soda glasses 450° to 500°C.; the Monax type 550° to 580°C; and the Pyrex type 570° to 610°C.

Resistance are similar glasses. Next in the series comes Pyrex glass, developed by the Corning Co., of U.S.A.; Phoenix and Chance's Hysil are of the same type. In these the silica content has been greatly increased, most of the alkali has been replaced by boric oxide as the fluxing agent, with its low expansion and greater mechanical strength; most of the remainder is alumina to give the glass good flame-working properties and mechanical strength. The constituents of these are mainly acidic in their nature, thus as would be expected, while they are highly resistant to water and to acids, they are less resistant to hot alkalis than are the Jena and the Monax glasses, which contain a proportion of the alkaline earths.

The Monax, Pyrex, Phoenix, and Hysil glasses are fairly freely available as tubing, which is used not only in conjunction with the furnace-blown articles, but also to make up much of the smaller apparatus used in the laboratory. They are particularly valuable for apparatus which is subject to sudden heat change, such as condensers, extractors, fractionating columns and all the accessories connected with standard ground joints and sintered glass filters. The use of gas-air-oxygen and gas-oxygen burners is now familiar for manipulating these glasses in most works and laboratories, and the ease with which they can be annealed is recognised. Glass No. 6 is Moncrieff Combustion, developed to withstand the red heat of a combustion furnace without sagging. No. 7 was developed for mercury vapour lamps, but is now used for combustions when a higher temperature is required than No. 6 will stand. The interesting point about

# Home News Items

**Education Gift.**—Courtaulds, Ltd., rayon manufacturers, have offered £30,000 to Bolton primary education sub-committee.

**Reclaimed Metals.**—Some 32,000 tons of metals in urgent request have been obtained to date by the breaking down of War Office military stores—ordnance, small arms, etc. Over 100,000 items of ordnance and 1,300,000 small arms have been broken down to recover steel, copper, brass, etc.

**Home Tin Stocks.**—Tin stocks held by consumers on January 31 were estimated to be 3910 tons, according to the Ministry of Supply. This compares with 4130 held by consumers at the beginning of the month. Ministry stocks were 7974 tons, compared with 7779 tons at the beginning of the month. Production was 3112 tons.

**G.P.O. Publications.**—For the first time in six years new and revised editions of those useful and informative Post Office publications, "Post Office Guide," (1s.) "London Post Offices and Streets" (9d.), and "Post Offices in the United Kingdom" (1s. 6d.) are once again simultaneously available for purchase at Post Offices.

**Books for Germany.**—An appeal for technical and other books and periodicals and for educational equipment is made by G.E.R. (German Education Reconstruction), and would-be helpers should write to the Secretary, 15 James Street, Long Acre, London, W.C.2, enclosing stamped envelope, for particulars of this officially-approved scheme.

**Sole Agents.**—Vickers-Armstrongs, Ltd., manufacturers of V.S.G. variable speed hydraulic transmission units and pumps, have appointed the Rockwell Machine Tool Co., Ltd., as their sole selling agents in the United Kingdom for all industrial applications. The Rockwell Machine Company has now set up a specialised department with qualified representatives to offer advice and technical service in connection with hydraulic transmission problems.

**Lord McGowan's Message.** — Lord McGowan, chairman of Imperial Chemical Industries, Ltd., on reaching England after a business trip to South America, repeated the message he gave to British people abroad wherever he contacted them: "We have weathered crises before and we will come through this one." Lord McGowan said he found a "great sympathy for Britain and a strong desire to trade when we have the goods." He added that "more industrial leaders should go to these countries to see the changing conditions for themselves" as correspondence alone is unsatisfactory.

**In Search of Carbon Black.**—A delegation is being sent to the United States by the National Joint Council for the rubber manufacturing industry with the object of finding larger quantities of carbon black in order to avert a large-scale stoppage in the industry.

**Saving Power.**—Lever Brothers are striving to cut their electricity peak load by half at Port Sunlight and Bromborough. Shift working has been introduced in the Port Sunlight oils and fat plants as from March 17.

**Sheet Steel Laboratories.**—Considerable expansion is projected for the laboratories established last autumn by Joseph Sankey and Sons, Ltd., for research in the production of sheet steel for the electrical industry. They are now to serve as the central laboratories for the research organisation set up by the Guest, Keen and Nettlefolds group.

**Power Units.**—Of special interest during the continued shortages of fuel and power is the information contained in the illustrated brochure now being distributed by Peter Brotherhood, Ltd., power plant specialists of Peterborough, of the many types of diesel engines which they supply for a variety of uses and especially for electric power.

**Scottish Co-operative Society.**—The Scottish Co-operative Wholesale Society, Ltd., which has been considering a scheme of major scientific research in industrial development over the past three years has now approved a modified scheme of concentration on food products research. The original scheme at a cost of £120,000 a year was vetoed as costing too much.

**New Joint Association.**—The British Food Manufacturing Industries Research Association recently formed a joint organisation representing the British Association of Research for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades and the British Food Manufacturers' Research Association, has appointed Dr. L. E. Campbell as Director of Research.

**Dyers Demand More Coal.**—At a meeting of the Cotton Board in Manchester, a demand was made that coal allocations be restored to 65 per cent of normal for more than 350 North-West dyeing, bleaching and finishing works employing 40,000 workers. An official of the Bleachers' Association said: "Our section of the industry uses twice as much coal in proportion to its size as the spinning industry. Unless we get increased supplies there will be immediate repercussions in shortage of cloth. The textile industry should be treated as a whole."

# PARLIAMENTARY TOPICS

IN the House of Commons during the past week, questions of interest to the chemical industry included the following:

**Groundnut Scheme.**—Mechanical equipment, appliances and stores to the value of over £100,000 have already arrived in Tanganyika and more is on the way to put into immediate effect the Government's plan to grow groundnuts on a large scale in East Africa. A Valentine tank is being used experimentally as a bulldozer.—The Minister of Food.

**Gas from Mines.**—The Minister of Fuel is studying a report submitted by Government departments on the prospects of underground gasification of coal. This was announced in a reply to Mr. Shawcross, who asked if the Minister would direct experiments to be carried out to test the possibilities of underground gasification, particularly in any closed pits which were not excessively flooded.

**Magnesium Chloride Imports.** — Col. J. R. H. Hutchison asked the President of the Board of Trade whether he will now allow import licences for similar quantities of magnesium chloride as those allowed for magnesite in view of the fact that approximately equal quantities of each are required for magnesite flooring. Mr. Belcher: No, sir. Magnesium chloride is produced in large quantities in the United Kingdom and, on balance of payment grounds, substantial imports cannot be justified.

**Soda from Kenya.** — Asked by Col. Ponsonby who controls the Magadi soda deposits in Kenya and what were the prospects of increasing output to relieve the shortage of sodium carbonate here, the Secretary of State for the Colonies (Mr. Creech Jones) stated: The Magadi soda deposits are worked by the Magadi Soda Co., Ltd., a subsidiary of Imperial Chemical Industries, Ltd., under lease from the Kenya Government. The present annual output is between 70,000 and 80,000 tons; and I understand that the company is doing its best by the renewal of plant to increase production to a maximum of 90,000 to 100,000 tons.

**Census of Production.**—A respite of a year is to be given to manufacturers before they are required to fill up the forms which will be needed for the national Census of Production. The announcement was made by the Parliamentary Secretary of the Board of Trade during the committee stages of the Statistics of Trade Bill. The Government, said Mr. J. Belcher, fully realises that this year is proving a particularly difficult one for manufacturers and "do not wish to add to their troubles in any way." Accordingly, the full census of production would be taken in 1949 in respect of 1948 "with the confident expectation that industry will co-operate wholeheartedly with the Government." The partial census for 1946 is to go forward as planned.

**Scientists Will Help.**—An assurance that representatives of the Scientific Advisory Council and the Department of Scientific and Industrial Research will co-operate with the proposed Joint Production Staff was given by the Prime Minister. Full use, he said, would be made of the existing organisations. He had earlier rejected the recommendation of Mr. G. Boothby that he should set up a scientific and technical sub-committee as an integral part of the projected planning machinery, to carry out research as the joint technical warfare committee did in the war.

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Denouncing the Government's control of industry, Mr. T. W. Oman, convener of the Paint and Oil Section of the Glasgow Chamber of Commerce, at a dinner in Glasgow on March 14, pleaded the cause of the private trader. Where the private trader had been allowed to exercise his native ingenuity and mobilise his resourcefulness he had never failed so signally as had Government administrators, Mr. Oman said. It was one of the unfortunate aspects of controls that in the eighth year of their existance so many people had come to regard them as a necessary evil.

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## NEXT WEEK'S EVENTS

MONDAY, MARCH 31.

**Scottish Engineering Students' Association.** Institution of Engineers and Shipbuilders, Glasgow, 7.15 p.m. Joyce E. McFarlane: The Production of Sound Iron Castings.

TUESDAY, APRIL 1.

**Hull Chemical and Engineering Society.** Church Institute, Albion Street, Hull, 6.30 p.m. Mr. W. A. Bristow: Low Temperature Carbonisation.

WEDNESDAY, APRIL 2.

**Society of Public Analysts and Other Analytical Chemists.** Burlington House, Piccadilly, W.1, 6 p.m. Dr. C. H. Lea: A note on the Chapman and McFarlane Method for the Estimation of Reducing Groups in Milk Powder, and Dr. W. R. G. Nelson: The Determination of Carotene in Dried Grass.

**Society of Dyers and Colourists.** Room 104, Leicester College of Art and Technology, 7 p.m. Dr. G. L. Royer: Studies on Wool Dyeing—Comparison of Methods for Applying Chrome Dyes.

# Overseas News Items

**Shortage of Lead in U.S.**—Supplies of lead available this year in the United States will meet only 80 per cent of the country's requirements, states the *New York Journal of Commerce*. The paint industry is among those hardest hit by the shortage.

**Swiss Imports from Germany.**—Switzerland received from Germany last year chemical and pharmaceutical goods valued at 3.9 million francs. Trade with the Russian zone is expected to increase following the recent visit to Berne of a Russian delegation which discussed transport matters.

**French Chemical Production.** — French chemical production for January remained practically on the December 1946 level. A decline by 10,000 metric tons to 65,000 tons in the production of mixed fertiliser has to be set against a welcome increase in the caustic soda and sodium carbonate output.

**Palestine Chemicals.**—Palestine's trade in chemicals, drugs, dyes and colours between January and July 1946 amounted to £P828,853's worth of imports and £P787,585's worth of exports. Palestine's total imports in the seven months were valued at £P35,814,181; exports at £P14.660,782.

**Alsace Potash Output.**—Crude potash output in Alsace totalled 3.55 million tons last year, against 3.25 million tons in the previous year. The $K_2O$ content rose from 550,000 to 600,000 tons. The Monnet plan envisages, *inter alia*, a modernisation and expansion of existing potash mines and plants to increase this year's output by some 10 per cent.

**U.S. Petroleum Decreases.**—The U.S.A., which until 1941 was the source of 60 per cent of the world's petroleum, now holds in the country less than 33 per cent of the world supply, a special committee of the U.S.A. Senate points out. By investments in 20 countries America, however, controls 46 per cent of proved petroleum reserves overseas.

**Groundnuts Scheme.**—A meeting has taken place in Dar-es-Salaam at which experts concerned with the British Government's scheme for production of groundnuts in Africa [THE CHEMICAL AGE, February 15, 1947, p. 255] conferred with the local Chamber of Commerce and the Tanganyika Price Controller regarding the demand on scarce commodities such as building materials, transport and labour. Close co-operation was promised, local businessmen apparently feeling that immediate difficulties would be more than compensated by long-term benefits.

**Aliphatic Organic Chemicals.**—U.S. output of aliphatic organic chemicals, derived mainly from petroleum, natural gas and coal, has been valued at over 1000 million dollars last year. Facilities for the production of these products are being constructed and expanded at an increasing rate.

**U.S. Copper Shortage.**—A growing shortage of copper, slightly more serious in the United States than elsewhere and likely to become acute by April, has been reported to Congress by the Federal Trade Commission. Copper consumers were, during March, to receive 30-35,000 tons of foreign-produced metal to supplement the inadequate domestic production.

**German Kaolin.**—Output of kaolin in the Russian zone of Germany is to be increased by 45,000 tons to 95,000 tons in the current year, as compared with 50,000 and 100,000 tons in 1946 and 1939, respectively. Before the war, total German output amounted to 400,000 tons annually and she received an additional 160,000 tons every year from Czechoslovakia, to be used for the manufacture of high-grade china.

**German Scientists for Australia.**—With a view to new and improved industrial processes, particularly in chemistry and possibly metallurgy, the Australian Government is planning visits by German technicians and scientists to Australia. Under the plan, which is being carried out in consultation with the British Government, only Germans with qualifications not possessed by Australians or Britons are to be considered.

**Competition with Malayan Rubber.**—If the Malayan rubber industry is to survive competition from neighbouring countries and also the American synthetic rubber production, extensive replanting of old seedling areas with high-yielding material will have to be carried out and new methods of cultivation and manufacture introduced. This was the opinion of Mr. Donald Farquharson, presiding at the annual meeting of the Negri Sembilan Planters' Association.

**Output of Tin in Malaya.**—There was a substantial increase in the last quarter of 1946, when 3008 long tons of tin ore were produced, compared with 5424 for the preceding nine months. There was a steady increase in the number of mines operating up to December, when the coal crisis developed; at that date 216 tin undertakings were in production. Tin production in the current quarter will be affected by the fall in Malayan coal output and the collieries strike.

## Personal

DR. C. L. HEWETT has joined the board of Organon Laboratories, Ltd.

DR. R. E. STUCKEY has been appointed chief analyst at the London works of British Drug Houses, Ltd.

MR. T. T. COCKING, chief analyst to British Drug Houses, Ltd., for 43 years, is retiring at the end of June.

MR. E. H. HURLESTON, technical superintendent of the Dunlop Rubber Co., Ltd., at Speke, has been elected a member of the council of the Institution of the Rubber Industry.

MR. G. P. BARNETT, a Deputy Chief Inspector of Factories, has been nominated by the Minister of Labour as Chief Inspector in succession to the late Mr. H. E. Chasteney.

MR. CYRIL M. COHEN, managing director of George Cohen, Sons & Co., Ltd., has now been appointed also to the chairmanship, succeeding Mr. Lawrence Levy, who retains his seat on the board.

DR. A. H. CAMPBELL, general manager of the Fermentation Division of Glaxo Laboratories, Ltd., who has been in charge of the Glaxo penicillin factory at Barnard Castle, Co. Durham, since its opening over a year ago, has been appointed an executive director of the company.

PROFESSOR SIR NORMAN HAWORTH, Director of the Chemical Laboratories and a former Dean of the Faculty of Science at Birmingham University, is to succeed Professor J. G. Smith as Vice-Principal, on the latter's retirement at the end of this session.

DR. ANDERSON W. RALSTON, to whose research at the Armour Research Laboratories in Chicago is due the assurance of United States iron ore supplies, which were declining, being extended for at least a century and a half, has been nominated for the 1947 Midwest Award of the St. Louis Section of the American Chemical Society.

The Committee of the Plastics Group of the Society of Chemical Industry have nominated the following officers for the 1947-48 session: Chairman, MR. N. J. L. MEGSON; vice-chairman, MR. G. DRING; hon. treasurer, MR. AUSTIN LOWE; hon. recorder, MR. C. E. HOLLIS; hon. hospitality officer, MR. W. H. LANGWELL; hon. secretary, DR. S. H. BALL.

DR. J. M. B. COPPOCK has been appointed by the British Baking Industries Research Association as the first Director of Research. Dr. Coppock, who is 37, is at present head of the Technical Development Laboratories of Boots at Nottingham. He visited Germany and Holland with a C.I.O.S. team in 1945. In 1933-35 he was lecturer in chemistry at the Robert Gordon Colleges, Aberdeen.

## Obituary

SIR JOSEPH BARCROFT, F.R.S., the eminent physiologist, died on Friday of last week, aged 74. He was well known for his work on the transport of oxygen by the blood.

Born in 1872, he entered King's College, Cambridge, and graduated in 1896. He was elected a Fellow of his college in 1900 and after lecture and research work was elected a Fellow of the Royal Society in 1910, president of the physiological section of the British Association in 1920, and Fullerian Professor of Physiology at the Royal Institution from 1923-26. He was knighted in 1935 and in 1942 was appointed director of the Unit of Animal Physiology under the Agricultural Research Council.

## Business Anniversary

Messrs. Abbott, Birks & Co., Ltd., of Abbirko House, London, S.E.1, recently entertained their staff and employees to celebrate the 25th anniversary of the business. Mr. C. D. Birks was in the chair, and was supported by his co-director Mr. Norman Birks, and Mr. W. Rowe, general manager. On behalf of the employees, Mr. Rowe presented inscribed silver tankards to the Directors on behalf of the Staff.

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The Manchester office of Monsanto Chemicals, Ltd., which was closed shortly after the outbreak of war, reopened on March 10, under the management of Mr. M. E. Meredith at 430 Manchester Royal Exchange, telephone Blackfriars 4520.

# Commercial Intelligence

**The following are taken from printed reports, but we cannot be responsible for errors that may occur.**

## Mortgages and Charges

**(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)**

MURRAY (SCIENTIFIC INSTRUMENTS) LTD., Liverpool. (M., 29/3/47). February 21. £10,091 5/0 mortgage, to City of Liverpool; charged on and at Kirkby Trading Estate, Kirkby, with buildings and erections thereon known as 3C1, 3C2, 3C3, 3C4, 3C5, 3C6, 3C7, 3D1, 3D1A, 3D2, 3D3 and 3D4, with fixed factory plant and fixtures. *Nil. February 20, 1946.

### Satisfaction

BRITISH EMULSIFIERS LTD., Bromsgrove. (M.S., 29/3/47). Satisfactions February 19, of mortgage registered April 27, 1938, and of debenture registered June 4, 1940.

# Company News

With a profit of £35,711, **R. B. Pullin Co., Ltd.**, is paying an Ordinary dividend of 12½ per cent (17½).

For the year to November 30, 1946 **Harringtons and Goodlass Wall Co., Ltd.**, reports a profit of £16,732 (£10,612), with a dividend of 12½ per cent (11½).

With a trading profit of £1,368,095 (£1,019,440) for 1946, **British Aluminium Co., Ltd.**, made a net profit of £447,345 (£294,825).

A net profit for 1946 of £237,878 (£94,337) is reported by **Monsanto Chemicals, Ltd.**, (controlled by Monsanto Chemical Co. of St. Louis).

A current dividend of 15 per cent (10), representing the total dividend for the year (10), is declared by **British Paints (Holdings).**

The nominal capital of **Icta Ltd.**, manufacturers of and dealers in tungsten, carbide, etc., Waterside South, Lincoln, has been increased beyond the registered capital of £5000 by £4000 in £1 shares.

For the year ending September 29, 1946 **Universal Asbestos Manufacturing Co., Ltd.**, showed a trading profit of £131,747 (£112,904), with a net profit of £29,974 (£21,253). An Ordinary dividend of 30 per cent (20) is announced.

An increase in profit from £20,246 to £56,425 is announced for **Paripan, Ltd.**, and a current dividend of 30 per cent (20) has been declared, making a total for the year

A final dividend for 1946 of 15 per cent is announced by **British Xylonite Co., Ltd.**, making a total of 20 per cent (10). Profits of the company's group have increased from £63,042 to £180,244.

The nominal capital of **East Anglia Chemical Co., Ltd.** Street One, Aycliffe Trading Estate, nr. Darlington, has been increased beyond the registered capital of £2,000 by £200 in £1 ordinary shares.

A trading profit of £283,723 (£184,665) was made in 1946 by the **General Refractories** group. The parent company's net profit was £89,405 (£68,931). A dividend of 10 per cent (7½ plus bonus 1½) is declared.

**British Aluminium Co., Ltd.**, is increasing its final dividend for 1946 by 2 per cent to 8 per cent, making a total of 10 per cent (8). Profit for the year was £1,368,095 (£1,019,440).

The name of John Lauder, Ltd., chemical manufacturers, etc., Church Corner, Southbourne, Emsworth, Hants, was changed to **John Lauder (Chemists) Ltd.**, on January 11, 1947.

The nominal capital of **Vivette Laboratories, Ltd.**, 7, Park Lane, London, W.1., has been increased beyond the registered capital of £1000 by £4000 in £1 ordinary shares.

Accounts for the year ended September 30, 1946 of **British Industrial Plastics, Ltd.**, show a profit on trading of £391,146 (£280,681), yielding a net profit of £44,512 (£23,516). Dividend payable is 12 per cent (8 per cent on smaller capital).

Rehabilitation of the Malayan tin industry is not progressing as rapidly as was expected, observed the chairman of **British Tin Investment Corporation, Ltd.**, in the annual statement. The Corporation's profit for 1946 was £42,424 (£26,404).

# Chemical and Allied Stocks and Shares

ANOTHER general fall in British Funds had a depressing effect on all sections of stock markets earlier in the week. Selling of gilt-edged stocks was again attributed to doubts regarding "cheaper money," though it is realised that if the Budget were to bring evidence of Mr. Dalton's confidence in his policy, gilt-edged stocks might rally strongly. Fears that earnings of a wide range of companies are running at a lower level and lack of confidence in the outlook regarding fuel supplies have been depressing

factors. Nevertheless, the lower prices were not followed by any heavy selling of industrials. Gilt-edged firmed up, but on the other hand the new Stock Exchange account failed to attract much buying interest owing to an increasing tendency to await the Budget.

Imperial Chemical declined to 42s. 3d. owing to the general market trend, though sentiment was also affected to some extent by reports that manufacturers of heavy chemicals are experiencing increasing competition in export markets. Turner & Newall went back to 83s. 3d., and Lever & Unilever to 52s., while, following their recent rise on the dividend increase, British Aluminium came back to 47s. 3d. Dunlop Rubber, despite higher dividend talk, receded to 68s. 10½d., while Associated Cement were no better than 62s. 3d., and British Plaster Board 31s. 7½d. At 131s. 3d. the units of the Distillers Co. have come back following their recent rally, while United Molasses were 54s. 9d., and Borax Consolidated deferred 57s. 6d. Earlier gains in electrical equipment shares were not held, though on the dividend increase, Associated Electrical were good at 78s. General Electric were 94s., and English Electric 65s. 6d.

British Industrial Plastics 2s. ordinary were 8s. 9d., at which there is only a small yield on the basis of last year's increased 12 per cent dividend; but, as in the case of most companies connected with plastics, the general assumption is that there are prospects of increasing profits and dividends. Kleeman shares came back to 93s. 9d., but, in other directions, British Glues and Chemicals 4s. ordinary have been firm at 17s. 6d. on higher dividend hopes. Amalgamated Metal shares eased to 19s. 3d. on the unchanged 3½ per cent dividend. Imperial Smelting were 21s., and General Refractories 23s. Despite the good impression created by the interim dividend, Low Temperature Carbonisation 2s. ordinary eased to 5s. 7½d. Paint shares lost the firmness which followed last week's dividend announcements. Pinchin Johnson were 55s., and International Paint £7½.

Iron and steels turned easier, with Stewarts & Lloyds 58s. 4½d., United Steel 26s. 3d., Dorman Long 28s., Guest Keen 47s. 4½d., and Tube Investments £6½. Hadfields, however, rose to 27s. 3d., following the increased profits and distribution, but in other directions, colliery shares receded after earlier gains, Powell Duffryn being 27s. 3d., while Staveley were 60s. 3d., and Shipley 46s.

Glaxo Laboratory shares fell back to £18⅞. Fisons were 62s., Greeff-Chemicals 5s. ordinary strengthened to 14s. 3d., and William Blythe 3s. ordinary marked 16s. 6d. British Alkaloids 1s. shares have been active on market dividend estimates, changing hands around 18s. 3d. Beechams deferred were 27s. 1½d., Griffiths Hughes 62s., Sangers 34s. 6d., and Timothy Whites 48s. 3d. Boots Drug receded to 60s. 6d., and in other directions, Triplex Glass were 35s. 1½d.

Oil shares, after recent strength, reacted in accordance with the general trend, oil shares came back sharply, particularly Anglo-Iranian, which were no better than £6⅞. Burmah Oil declined to 80s., Shell to £5, and V.O.C. to 81s. 3d.

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# British Chemical Prices

## Market Reports

ACTIVITY in the industrial chemicals market is again restricted and there has been little, if any, change in the general conditions reported last week. Overseas inquiries have been much in evidence but uncertain delivery dates are not helpful in this direction. A strong price position obtains in most sections of the market and price advances would not be unexpected. In the fine chemical market potassium and sodium bromide, and chloroform are dearer. A routine trade is reported in coal-tar products with supplies generally struggling to keep pace with demand.

MANCHESTER.—Strong price conditions are maintained in all sections of the Manchester chemical market and supplies of most descriptions of both light and heavy products are moving readily into consumption. Fresh inquiries during the past week have been mainly on home trade account, though there has been a sprinkling for shipment. Caustic soda, soda ash and the other alkali products are meeting with a good demand, and steady pressure for the restricted supplies of the potash chemicals is also reported. Active conditions are being experienced in several sections of the fertiliser trade. In the tar products market a good demand is reported for pretty well all classes of both light and heavy materials.

GLASGOW.—The Scottish heavy chemical trade improved a little during the past week with better road conditions. Inquiries and orders are still being turned down because manufacturers in this country are not getting sufficient raw materials. Inquiries in the export market continue in the usual volume but certain markets abroad are finding difficulties in obtaining import licences for numerous chemicals and solvents, both from this country and America. China appears the most seriously affected market in this respect. Business has, however, been secured for such materials as sulphuric acid, precipitated chalk, trisodium phosphate, sulphur, potassium nitrate and sodium sulphate. Acceptance of these orders is difficult under letters of credit, as prices usually increase before delivery and shipping space can be obtained.

# Patents in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of specifications accepted may be obtained from the Patent Office, Southampton Buildings, London, W.C.2., at 1s. each. Numbers given under "Applications for Patents" are for reference in all correspondence up to acceptance of the complete specification.

## Complete Specifications Open to Public Inspection

Penicillin salts of alkali and alkaline earth metals.—Hoffmann-La Roche, Inc. July 19, 1945. 21103/46.

3 - cyano - 4 - benzyloxy - 6 - methyl - 2 - pyridone and benzyloxyacetylacetone.—Hoffman-La Roche, Inc. July 17, 1945. 21391/46.

Derivatives of polyvinyl alcohols.—Imperial Chemical Industries, Ltd. February 23, 1944. 4580/45.

Pressure sensitive adhesives.—Imperial Chemical Industries, Ltd. July 14, 1945. 20876/46.

Adhesives.—International Bitumen Emulsions Corporation. March 7, 1944. 16021/45.

Recovery of alkaline metal compounds.—H. W. Lehrecke. July 18, 1945. 21423-27/46.

Chemical compounds.—Merck & Co., Inc. July 17, 1945. 19727/46.

Citric acid and salts thereof.—Merck & Co., Inc. July 17, 1945. 21186/46.

Substituted dihydroimidazolium compounds and the organic compounds resulting therefrom.—Monsanto Chemical Co. July 14, 1945. 20598-99/46, 20891/46.

Substituted imidazolium compounds, and the organic compounds resulting therefrom.—Monsanto Chemical Co. July 14, 1945. 20600-1/46.

Aqueous dispersions of polymers of substances capable of polymerisation.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. July 20, 1945. 10483/46.

Contacting liquids continuously and in countercurrent.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. July 19, 1945. 17120/46.

Separation of fatty oil substances.—Texaco Development Corporation. July 17, 1945. 20758/46.

Synthetic rubber.—Wingfoot Corporation. July 19, 1945. 26555/45.

Treating starch and the starch product resulting therefrom.—Xorn Products Refining Co. July 18, 1945. 9294/46.


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Substituted pteridines and intermediates thereof.—American Cyanamid Co. July 23, 1945. 12336-39/46.

Ultramarine.—American Cyanamid Co. July 24, 1945. 20203/46.

Secondary ultramarine from primary ultramarine.—American Cyanamid Co. July 24, 1945. 20204/46.

Compositions for use in margarine.—American Lecithin Co. July 23, 1945. 21272/46.

Polyol compositions.—Atlas Powder Co. April 23, 1943. 9683/44.

Dyes.—British Celanese, Ltd. July 24, 1945. 22078/46.

Polyazo-dyestuffs.—Ciba, Ltd. July 26, 1945. 21276-77/46.

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Recent trade literature received includes an instruction booklet from Industrial and Scientific Instruments, Ltd., relating to the detergent strength meter, Type 5a; a catalogue (ND46(1)) from Leeds & Northrup Co., 4907 Stenton Avenue, Philadelphia 44, Pa., describing the "Speedomax" Type G pyrometers for measurement and control. The latest data in booklet form concerning twelve chlorine compounds of Carbide & Carbon Chemicals Corporation, 30 East 42nd Street, New York 17; a 1947 catalogue of books on chemistry and other technical and scientific subjects published by Chemical Publishing Co., Inc., Brooklyn 2, New York; and—for overseas customers only—a booklet descriptive of series 1-16 of the "Crillex" surface-active agents, manufactured by Croda, Ltd., Snaith, Goole, Yorks.


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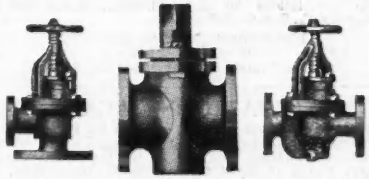
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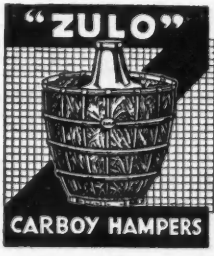

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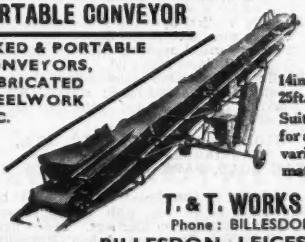
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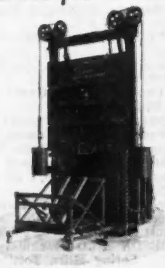

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